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Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

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Professor Hertz Honored.

THE bestowal of the Rumford medal of the Royal Society on Professor Hertz is a well-deserved recognition of his great services to modern electrical theory. About two years ago the news of his experiments came like a lightning flash to make clear the way in which we should look for immense developments. Nor has the subject since lapsed into complete darkness, for while Professor Hertz's experiments are as yet not fruitful in practical results, since their first publication there has been a steady increase in our knowledge of electrical theory. The Rumford medal could not have been given to one more worthy of the honor that has already been bestowed on a long line of distinguished men.

A Lamp Rheostat.

WE illustrate in the present issue a very simple form of regulator for incandescent lamps. One of the allegations sometimes brought against the electric light is the inability to graduate its intensity as can be so readily done with gas or lamps. An incandescent lamp cannot in its ordinary form be turned up or down; it can only be lighted or extinguished. For the purpose of avoiding this occasional disadvantage a number of simple rheostats have been designed to regulate the intensity of the light by inserting a variable resistance in series with it. The present form is a singularly compact and simple one, and gives promise being a very convenient lamp regulator. Of course in inserting resistance there is a considerable amount of energy lost as heat, so that the expenditure of current is by no means proportional to the light developed. Still, a lamp turned down by means of a rheostat consumes quite a little less energy than when turned at full candle power, so that the cost of operating a night lamp, for example, where electricity is metered, is by no means as great as the regular lamp rates. No form of lamp rheostat has yet come into extended use, although one hotel at least is equipped with a device of this kind; but there is certainly a wide field for a cheap and reliable form of regulator.

Electric Lighting in the Home.

THE time is happily now past when the incandescent lamp is to be regarded as a luxury, highly desirable, but put by its high price out of the reach of most who would wish to enjoy its advantages. People scarcely realize how well the little glow lamp can compete with gas, even in the field of domestic illumination. Where conditions are favorable it is quite practicable to supply 16 c. p. lamps at a rate equivalent to one cent per lamp per hour and yet obtain a fair return on the investment. To be sure such a low price cannot now apply to all places or under all conditions, but still it is by no means uncommon even now and will be more frequent in the near future. And consider what one cent per lamp per hour means. A 16 c. p. lamp is at least the equivalent in lighting power of a gas burner consuming five cubic feet of gas per hour. At that rate of burning one would obtain 200 lamp-hours per thousand feet of gas. So we see that to-day it is fair to say that, so far as price is concerned, electric light is quite as cheap as gas at $2 a thousand feet—a price far lower than the average in places of moderate size. Suburban towns, in particular, often suffer under an extortionate gas rate, and it would be well if more of them summarily abandoned the flickering gas flame and its evil smelling concomitants, and installed the incandescent lamp that can give an immensely better light at a less cost. It is high time for electric lighting to take the aggressive, and we are happy to say that every thing indicates that it is gathering its forces for a general assault all along the line that will put the gas monopoly in many a town to disastrous rout.

Trials and Tribulations.

A VERY amusing letter was recently received by one of the storage battery companies from a customer in another State, exhibiting so well the difficulties with which the electrician has to contend that we have published extracts from it elsewhere in our columns. A certain class of people seem to think that electrical apparatus can be handled with as little preliminary training and with the same wild freedom as an axe. They fondly imagine that electricity is a self-directed and self-guiding force that can be trusted to accomplish results quite apart from any knowledge of its proper management. Really, however, this letter is anything but a fair exponent of the general state of the public mind toward electric matters, for the storage battery has been especially unfortunate in this respect. Heralded as it was by loud blasts from the horns of innumerable inventors and pushed forward ten years ago as the probable solution of all electrical difficulties, it has not been given the share of intelligent study on the part of electricians and the public that is its real due. Consequently for several years it fell into disrepute, but it is now gradually assuming the position which its real importance merits. Skillfully handled, the storage battery can accomplish a great deal, but without intelligent care it is liable to prove anything but satisfactory. It has been especially neglected in popular works and even text books on electricity, and the average man who is well informed on other electrical matters usually has very vague ideas as to the practical management of accumulators. It is to be hoped that this unfortunate condition of things will not long continue, for in the accumulator the electrical industry certainly has a very useful servant, although one that must be rather gently treated. The storage battery of to-day is very much more practical than that of five years ago; it requires less attention, and is less likely to deteriorate; but, nevertheless, it cannot, as yet, be trusted to operate itself.

Engine and Dynamo.

VERY recently we published some interesting experiments on the efficiency of a combined engine and dynamo. Close upon it now comes a series of rather elaborate experiments covering the same ground and showing results that ought to be highly satisfactory to the makers. We refer to the article in another column on the test of the Goolden & Co. steam dynamo. It is, like most others of this class, a combination of an especially high speed engine with a specially low speed dynamo on the same base. Early attempts at designing this class of apparatus were not altogether successful, but, as time has gone on, the conditions which governed this really difficult kind of work have been more thoroughly understood and far better results have been obtained than were at first to be anticipated. The most instructive part of the test is the curve showing efficiencies at various loads. This deserves very careful attention, for there is altogether too much tendency to regard a dynamo as having a comparatively fixed efficiency, and it is safe to say that the direful effects of underloading are not thoroughly appreciated by many engineers. The total efficiency obtained from the steam dynamo under consideration from full load was 81 per cent., while at quarter load it had fallen to 57½ per cent. The effect of this lower efficiency on the amount of fuel consumed is most disastrous, and it is doubly bad because not only is the efficiency of the combination low, but the engine itself is so much underloaded as to work at a great disadvantage. The best results from the combination of an engine and dynamo, whether directly or through the medium of belting, is obtained when the driving engine at full load is working at its most economical point of cut-off. This, however, imposes the almost ideal condition of steady load. Under practical conditions a dynamo is often run at considerably less than its maximum output, and if an engine is to be worked to advantage under these circumstances its capacity must be such that it will give its greatest economy at about average load. In the particular case we are considering both engine and dynamo showed friction in amounts rather larger than is desirable; but the machines were perfectly new at the time, so that it is not fair to judge them by the results of this test. It is worth noting that the loss in the armature core was quite considerable, amounting to 1.64 horse power, a quantity decidedly greater than the losses in the friction of bearings, and nearly as great as the loss in armature resistance at full load. A full series of experiments of this kind tried with dynamo directly belted to the engine would be full of instructions to electrical engineers, and would illustrate in the most forcible manner the necessity of treating engine and dynamo combined in the designing of electrical equipments, rather than following the too frequent custom of installing a dynamo large enough to do the work and an engine of the first size or kind convenient.

Municipal Lighting.

THE National Electric Light Association has just issued for general distribution the paper on municipal lighting, read at the last convention by Mr. M. J. Francisco. When first presented Mr. Francisco's discussion attracted a great deal of well-merited attention, and was so enthusiastically received that the present special publication was ordered by the association. As is tolerably evident from what has already appeared on this topic, the question of municipal lighting is a very complicated one. Accusations and mutual recriminations have been the order of the day, the position on the part of municipal governments being that in furnishing electric light the profits might as well belong to the municipality as to private corporations, while the contention on the part of the electric light companies has been that they could produce the light much more cheaply than if under city control. The questions have been purely in regard to the facts and the legitimate deductions to be drawn from them. Looking at the matter from the standpoint of an unbiased spectator, it resolves itself into somewhat the following form: Is the increased cost of municipal administration, owing to political complications, sufficient to overbalance the profit that will be paid to a private corporation for the required service? Aside from maladministration there is no conceivable reason why a municipality should incur more expense in running a given number of electric lights than would be met by a corporation. On the contrary, it should be able to purchase equipment and supplies on at least as favorable terms as any other organization. And in cases where there is already a city electrical service it may be able to combine its electric lighting to the advantage of both departments. The principal disadvantage of municipal government is that its rate of wages is usually somewhat higher than paid elsewhere in the same vicinity. The figures selected by Mr. Francisco show in many cases municipal mismanagement and a sort of juggling with statistics that would be regarded by most corporate organizations as very bad bookkeeping. On the other hand, it is a legitimate criticism to say that a city deserves to reap all the advantage it can from the combination of its various departments, allowing them to assist each other in every possible way, and it is very certain that no little economy may sometimes result from such a combination. It is unfair to make estimates on the cost of an hypothetical power station when a city government is able to accommodate its electric light plant in quarters already at hand with comparatively small additional expense. It may thus be seen there may be legitimate advantages gained by municipal control, while on the other hand there is the growing constant danger of political mismanagement. When this can be successfully shunned, as it has been for example in Chicago, it is probable that municipal lighting can compete on at least equal terms with lighting by corporations, but it is somewhat dangerous in view of the disaster that has attended the operation of some municipal plants to draw the conclusion that cities can get along without electric lighting companies unless under especially favorable conditions. Political jobbery is more than likely to cause expenses which would be quite unknown in an ordinary private organization. Municipal lighting is a somewhat hazardous experiment, and while it may lead to admirable results, these would be obtained only under conditions more favorable than are usually found in the case of political administration.

Latest Foreign Electrical News.

(By Cable from our Regular Correspondent).

LONDON, Dec. 1, 1890.—The annual meeting of the Royal Society will be held to-day, and it is expected that Sir William Thomson will be elected president in the place of Sir George Stokes retired. The Rumford medal will be presented to Prof. Heinrich Hertz for his researches upon electromagnetic radiation, and the Royal medal will go to Dr. John Hopkinson for his investigations of magnetism. A reception in honor of Professor Hertz was given by Professor Ayrton yesterday at the Langham Hotel.

The opening of the City & South London Railway, announced for Nov. 26, has been deferred for a short time; the original announcement was unofficial and represented only the approximate date.

The Blackpool Electric Tramway has declared a dividend of seven and one-half per cent.

M. Reynier has just published details of the elastic accumulator as applied to traction purposes, and his report seems decidedly favorable.

There is a prospect of a better cable rate to Australia, for the four principal governments decided to recommend to their respective legislatures to vote the guarantee required for the cable extension in order that the rates might be reduced to four shillings a word.

Electrical World Portraits—XVIII.

JOHN P. BARRETT.

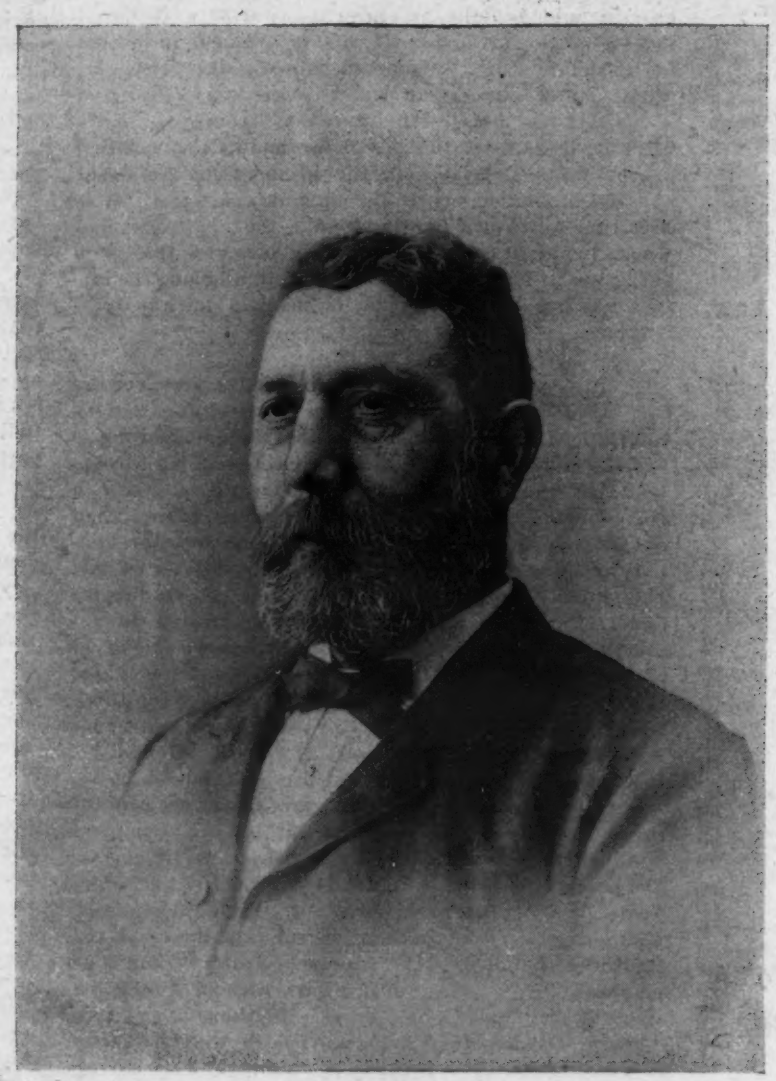
It gives us great pleasure to present herewith a portrait of Mr. John P. Barrett, prominently mentioned as director of the electrical section of the World's Columbian Exposition. Mr. Barrett has been so closely identified with the electrical work of Chicago during the last 20 years that his name is a familiar one throughout the country, and his appointment will be a gratification to a host of friends, and a guarantee of an upright and efficient administration of the work in the electrical section.

John P. Barrett was born in Auburn, N. Y., 53 years ago, but may lay claim to being one of the old inhabitants of Chicago, as he came to that city at the age of seven, and has been a resident of it ever since. His career has been an interesting one. As a young boy he went to sea, but an accident in a furious storm off the coast of Chili injured him so severely that he returned to Chicago in 1865 and soon after began his connection with the fire department, which he has so long and faithfully served. He was at first appointed fire watchman in the glass tower on the City Hall to watch for the first signs of fire and sound the alarm. During this period he turned his attention to repairing the defects of earlier education, and gradually put himself in a position to handle intelligently the wider field of duties into which his abilities soon carried him. When the fire department was fully organized and a telegraphic system was established between its various sections, Mr. Barrett was appointed battery man and assistant operator. With only a passing knowledge of telegraphy, he entered his new position, and before long had become an expert operator, thoroughly versed in the apparatus under his care. A little later as chief of the electrical work of the city he was given a more extended opportunity to display his ingenuity, and succeeded in introducing many important modifications and improvements into the fire alarm service. Piece after piece of apparatus to facilitate the distribution of fire alarms and to establish better communication between the various points at which fire apparatus was placed was introduced until finally, very largely as a result of Mr. Barrett's intelligent labors and the skill that he has shown in utilizing the ingenuity of his subordinates to the best advantage, he has brought the fire service of Chicago to a point hardly reached anywhere else in the world. Beside this, the police patrol system, the underground telegraph system, the bridge telephone system and others have been the product of his assiduous labors to improve the city electric service. But it is principally in connection with the municipal lighting plants of Chicago that he has become widely known.

Realizing that the time must come when overhead electric light wires would not be tolerated in the streets of a great city, Mr. Barrett early turned his attention to the problem of underground conduits, and, facing it boldly, brought it to a successful solution. While engineers in other parts of the country were slow to meet the difficulties of the situation, Mr. Barrett went quietly ahead, securing the best apparatus, the best expert services that could facilitate his work, and solved the question of putting wires underground by putting them there. The result has been eminently successful, and, under his careful management, not only is the electric light service of the city admirably administered, but it is operated with a degree of economy that compares favorably with the best that could be done by private corporations.

Chicago is one of the few cities where municipal lighting has been thoroughly successful, and the result is very largely due to the individual energy and administrative ability of Mr. John P. Barrett. Year by year the plant has been extended until now Chicago is one of the best lighted of cities, entirely free from the trouble and disfigurement of overhead wires. Through administration after administration Mr. Barrett's ability and energy have been recognized, and whatever political changes might go on in the city government the value of his services has been recognized and his position has been secure. The same business capacity and powers as an organizer and administrator that have made the electrical service of the city unsurpassed may be trusted to carry the electrical section of the World's Fair to unqualified success. Of unimpeached integrity, unhampered by affiliations with any electrical companies, Mr. Barrett can inspire full confidence in the electrical fraternity at large.

Mr. Barrett is a man who has won by years of faithful and upright administration the confidence and respect of the community in which he has labored for the establishment of an economical system in the conduct of the electrical affairs of one of the largest and, from a commercial point of view, most important cities of the country. Personally Mr. Barrett has won many friends throughout the country and the way they rallied to his support when it was proposed to place him at the head of the electrical section was sufficient witness of their opinion of him. Nearly every prominent electrician and electrical company signed a petition for his appointment, feeling that it would secure impartial justice to all and would be an augury of unqualified success. Altogether Mr. Barrett is a representative of the best type of the self-made man, and his long connection with electrical affairs has given him both practical experience and a rare degree of executive ability that cannot fail to make his future services of the greatest value to the city he has served so faithfully.



JOHN P. BARRETT.

Electric Lighting on Staten Island.

The Richmond Light, Heat and Power Company is well known as one of the pioneers in the field of incandescent electric lighting by means of the alternating current, and under an excellent management it has grown to be one of the most successful and prosperous companies now in operation. The organization of the company was effected only about three and a half years ago, when it began to furnish arc lights from American dynamos and incandescents from Edison No. 12 machines to two individual concerns from a comparatively insignificant plant. The necessities of the service at that time required the transmission of current to only a very short distance and the continuous current system was found well adapted to the purpose. But the territory over which the company was soon called upon to supply current for both arc and incandescent lights proved to be so large that lines of feeders, in some cases reaching five miles in length, were rendered necessary. To transmit current to this distance economically the company adopted the alternating system of the Westinghouse company, which was at that time just coming into commercial use. The economy of the alternating current distribution by means of transformers has proved so successful and the service rendered so satisfactory, that at the present time the company's lines run to various parts of Staten Island, carrying current to about 6,000 incandescent and 175 arc lamps. This remarkable growth attests not only the increasing popularity of the electric light, but the excellence of the service which the company has continued to furnish to the consumers of the electric current.

The central station of the Richmond Light, Heat and Power Company is located at St. George, on Staten Island, only a short distance from the landing of the ferryboats from New York. Both in its exterior design and in interior construction the station is well adapted for the purpose which it is intended to serve. The exterior appearance of the buildings in which are located the office of the company, the dynamo room, the repair shop and the engine and boiler rooms is well shown in the illustration at the top of the opposite page. The boiler plant is placed in the end adjacent to the chimney, while the office occupies the other extreme wing of the building, the engines and electrical machinery being arranged between these two extremes.

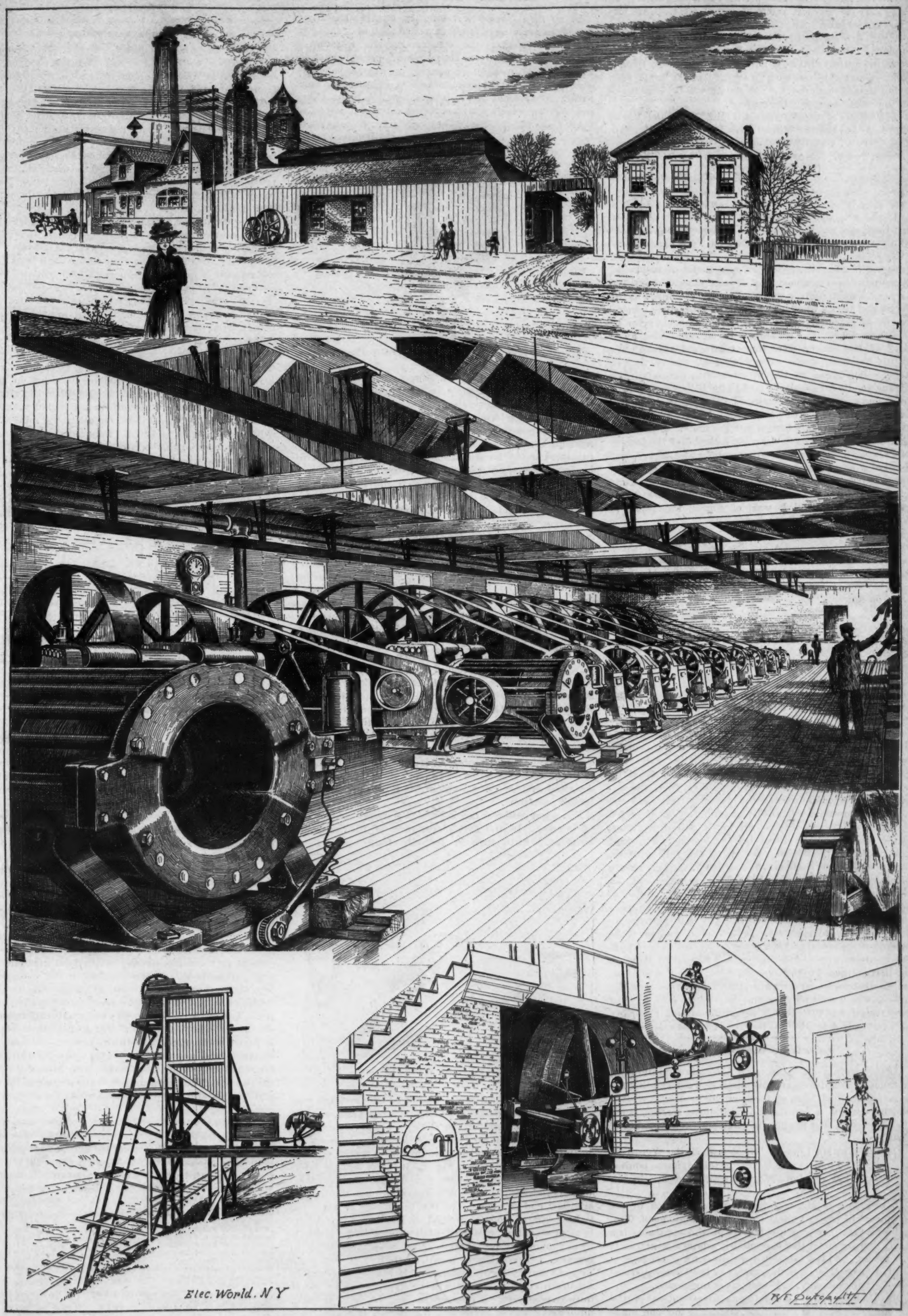
The view shown in the centre of our page illustration is that obtained as one enters the large dynamo room from the office of the general manager, Mr. W. Dwight Wiman. Arranged in systematic order along the centre of the room are two Thomson-Houston arc dynamos of 50 lights capacity each, two Wood arc light dynamos, four Westinghouse alternating current machines of 750 lights capacity each, one of the same type of 1,500 lights capacity, and one of 1,300 lights. The six alternators are separately excited by two Edison No. 12 machines of 240 ampères capacity each when run at a pressure of 125 volts. Only one machine is needed for the regular service, and the other is kept as a reserve, the two being run alternately.

The power for driving the dynamos is derived partly from independent engines belted direct to the generators, and partly from a 500 h. p. slow-speed engine connected through a countershaft to five alternators and their two exciters. Two 65 h. p. Armington & Sims engines are each connected to one Thomson-Houston 50-light arc and one American arc machine. Another 65 h. p. engine of the same type is directly belted to a 750-light Westinghouse alternator. The other five alternators and the Edison exciters are driven from the Corliss engine. The countershaft is placed at the rear of the dynamo room, on the same floor, and is six inches in diameter and 48 feet long, and composed of three sections of equal length. This shaft is supported by six bearings, and is fitted with seven pulleys, two of which are 54 inches in diameter and five of 88 inches. Each pulley is provided with a Hill clutch, by means of which any one of the five alternators or two exciters may be thrown out of connection with the shaft and stopped whenever desired. The shaft is driven at a speed of 300 revolutions per minute. Chas. A. Schieren & Co.'s leather belts are used throughout the station, one of them being of the perforated type. C. P. Beckwith's mixed animal and mineral oil is used on all the dynamo bearings, and gives excellent satisfaction. The switchboard in the dynamo room is so arranged that any circuit in the whole system can be run from any dynamo adapted to that circuit. Rheostats are placed in series with the field circuit of each alternator and also with the field circuit of each exciter, so that it is possible to regulate the field circuits of the alternators independently or all at once, as the necessities of the case demand. No attempt is made to operate the alternators in parallel, although when the station was first started this method of operation was tried for some time. Each machine runs in an independent circuit.

The Hamilton-Corliss engine which drives the countershaft is placed on a floor below that upon which the dynamos are located. It is a single cylinder engine, making 75 revolutions per minute, the cylinder being 28 inches in diameter and the length of the stroke 60 inches. The flywheel is 20 feet in diameter, with a 50-inch face, and is connected to the countershaft by a 48-inch belt. The engine was installed by Mr. W. A. Hammett, of this city.

The boilers that supply steam are six in number, three of them being of the tubular type of 75 h. p. each, two of Abendroth & Root's of 155 h. p. each and one Morrin boiler of 300 h. p. The steam pressure is maintained as nearly as possible at 80 pounds. Pea coal is used and is brought to the company's own siding near the station directly from the tracks of the Baltimore & Ohio Railroad. The coal is discharged from the car by gravity and is then elevated by means of buckets carried on an endless belt to a large bin above the track and from here it is carried by a suitable chute into a small car that runs from the coal bin directly into the boiler room. The method of handling coal is shown at the lower left hand corner of the page illustration.

Repair work on armatures, converters, etc., is all done at the central station by the company's employés. No wiring is done by outside parties, and no accident has ever occurred from fire or other cause where the company has installed its wires. At the present time the company is



THE RICHMOND LIGHT, HEAT AND POWER COMPANY'S PLANT ON STATEN ISLAND.

furnishing lights to about 60 private residences, with from 10 to 150 lights in each, and to about 350 stores. All circuits are supplied with Shallenberger meters and one cent per 16 c. p. lamp-hour is the uniform price charged to consumers. The village of New Dorp, nine miles distant from the central station, is now being wired for electric lights, about 40 houses with an average of 25 lights each being already equipped. A sub-station will be established in the village to supply the current.

The officers of the Richmond Light, Heat and Power Company are Erastus Wiman, president; Samuel Hughan, treasurer; W. Dwight Wiman, general manager and electrician, and W. Keutgen, secretary.

Electrical Reception.

The Twenty-sixth street station of the Edison Illuminating Company was the scene, on Tuesday evening, Nov. 25, of a very pleasant reception to the New York Electrical Society by the officers of the company. The immediate purpose was to afford the society an opportunity of inspecting the admirable arrangements of this important central station. At eight o'clock the guests were assembled in full force, and after a brief address of welcome, some general words of explanation regarding the station were given by Mr. Van Vleck, the electrician in charge. The members of the society were then conducted through the entire building, seeing everything that was of importance. Beginning at the upper story, the admirable arrangements for supplying coal to the boilers were looked over, and a glimpse was obtained of the results of careful firing as shown by the absence of smoke and exhaust steam, the latter being turned into the stack. Descending then into the boiler room the party looked over the battery of Babcock & Wilcox boilers that supply the power, and general admiration was excited by the unusually skillful firing that made itself evident both in lack of smoke and in general results. The dynamo room itself, in which the party had first assembled, was, of course, the object of special interest. It is most compactly arranged, and is divided down the middle by an electrical gallery containing all the regulating apparatus and measuring instruments. On the west side of the gallery are the dynamos, 10 in number, all of them No. 32 machines of the familiar Edison type, of 80,000 volts capacity each. The east side of the dynamo room will soon be occupied by additional machinery. The driving is done from the engine room immediately below the dynamo room, and the battery of engines consists of five Armington & Sims 200 h. p. machines, each of them driving a pair of dynamos in the room above by direct belt connection. The load now carried by the station is not up to the full capacity, but about 18,000 lights are connected, and more are being added every week. The arrangement of the station throughout is admirably compact and convenient. The plans of the station have already been published in The Electrical World, so that perhaps no further details are necessary. It is a capital example of the modern city station, and is a credit to its designers and administrative corps. After inspecting the entire building the party returned to the dynamo room, where a most attractive collation was spread, and later adjourned with the feeling that a most pleasant and interesting evening had been passed, and that the Edison Illuminating Company had certainly done all in its power to entertain its visitors.

FIG. 3.—PULL-OFF BRACKET.

Cornell University Notes.

At the meeting of the Electrical Association on the 10th, Instructor Saunders gave his method of determining the direction in which lines of force circulate about a wire in which a current is flowing, the basis of his method being the assumption that the lines of force possess the quality of elasticity.

On the 17th Mr. Lindsay, '91, described the Wenstrom dynamo. The remarkable feature of this dynamo pointed out was the low speed of 300 or 400 revolutions at which it runs.

A new belt-testing apparatus has been added to the equipment of Sibley College through the kindness of Wm. Sellers & Co. The principal feature of this apparatus is a costly dynamometer that is peculiarly adapted to practical belt-testing, and is a valuable acquisition for the college.

Mr. Herschel, '90, is in the employ of the Thomson-Houston Electric Company, at Boston, as draughtsman.

Mr. Thomson, R. G., is making an investigation of the Thomson-Houston arc machine, similar to the one made of the Stanley dynamos by Tobey and Walbridge last year, the results of which were recently published in The Electrical World.

Some Street Railway Appliances.

In no field of electrical industry has the ingenuity of inventors been more freely exercised than in devising apparatus to facilitate the construction and operation of electric street railways. The peculiar requirements of the overhead line work of an electric railway has called out numerous important modifications of existing line apparatus. We present herewith three novelties in the electric railway line which possess sufficient interest to attract attention of our readers. They are, like the aluminium trolley and the novel trolley base recently described in The

FIG. 1.—SUSPENSION FOR TROLLEY LANE INSULATOR.

Electrical World, the invention of Mr. Charles Lieb, of this city, and they certainly ought to prove most convenient in overhead construction.

Fig. 1 shows a form of suspender for trolley line insulators which possesses many good features. It is, as will be seen, an insulated ring passing over the cross wire and furnished at the lowest extremities with a screw for holding the customary bell insulator. The ring itself is provided with a steel core, around which the insulating material is formed, and it both gives additional freedom from leakage and provides a flexible support for the trolley wire that is free to give rather than to break, and to allow the easiest possible passage of the trolley. Fig. 2 shows a trolley wire holder. Any one who has had experience in overhead construction knows how difficult it is to obtain a holder that will grip the wire satisfactorily, and at the same time be easy to put on and adjust. The present device consists, as will be seen, of a pair of jaws, which are forced together in raising the screw support into its proper perpendicular position below the bell. When it is closed the tension on the trolley wire constantly tends to keep the jaws tight and hold everything in its proper position. Combined with any ordinary form of insulator this makes a capital means of quickly and easily grasping the trolley wire and holding it in the position desired, while the ring which we have just described enables free movement, and will prevent many broken insulators.

Fig. 3 is a pull-over bracket which possesses some points of interest. In the first place, each of the insulating arms is free to turn in the clip that supports the trolley wire, so that they can be placed at any angle, can serve as a curve bracket, a simple pull-over bracket, or, if desired, as a support for the trolley wire in its ordinary position. The arms are capable of almost any ordinary adjustment, and the insulation secured by a special method, which is readily seen from Fig. 3. In each arm is interposed a straight hard wood bar soaked in paraffine, or otherwise specially insulated. It is slipped through the holders at either end in such a way that the harder it pulls the tighter will the wood be gripped, and as the strain is directly along the fibres, it is well nigh impossible to break it by any amount of force which could be applied to it in practice. In combining great flexibility of use with strength and excellent insulation, this bracket is certainly singularly convenient, and will be appreciated by street railway engineers. It possesses, as will be seen at once, numerous points of excellence, the details of which construction have been worked out with unusual care, as is the case with the other pieces of apparatus we have just mentioned.

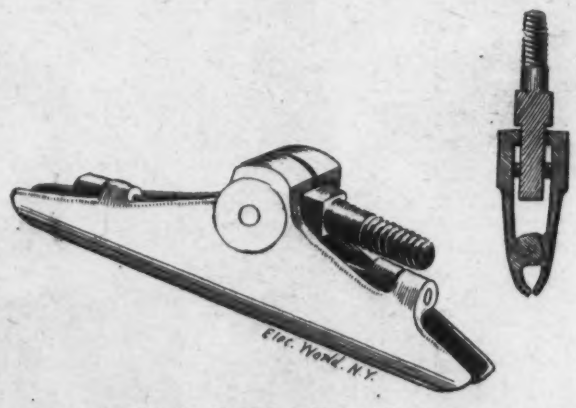


FIG. 2.—TROLLEY WIRE HOLDER.

Electrical Distribution by Transformers from Central and Eccentric Stations.*

BY DR. J. A. FLEMING, M. A.

§ 20. *House-to-House Central Station at West Brompton.*—The House-to-House Electric Lighting Company has established at West Brompton, in London, a very complete transformer station on the Lowrie-Hall system.

The site of the station is a plot of land 470 feet long by 60 feet wide, adjoining the Metropolitan District Railway. On this site has been erected a central station capable of supplying current to about 48,000 50-volt 10 c. p. incandescent lamps. The general appearance of a small portion of this station is shown in Fig. 55, and the whole station comprises dynamo and engine room, boiler house, testing rooms, offices, stores, drawing and engineer's offices, water tank, coal stores, etc.

The station when completed is intended to have 12 unit plants, each consisting of an engine, boiler, dynamo and exciter, and capable of giving an electrical output of 100,000 volts. At the present time three such unit plants are actually in place, and the remainder will be added as required. The present supply is to about 16,000 eight c. p. 50-volt lamps, some 10,000 of which are at full load, burning at one time. The supply is to numerous private houses, flats, shops, St. Jude's Church and other public buildings.

Each alternator is driven by a 200 h. p. horizontal coupled compound engine, by John Fowler & Co., of Leeds. The high-pressure cylinder is 15 inches in diameter, the low-pressure 25 inches in diameter; the stroke is 30 inches, and the initial steam pressure is 130 pounds per square inch. The speed is 88 revolutions per minute. The cylinders are steam jacketed. Between the high-pressure and low-pressure cylinder is suspended a massive flywheel, 14 feet in diameter, grooved for seven one and a half inch ropes. The engines are governed by Hartnell's governor, which is driven from the shaft by cotton ropes, and controls the engine by acting directly on the expansion valves of the high and low pressure cylinders, giving a range of cut-off in the hi gh-pressure cylinder from one to sixty per

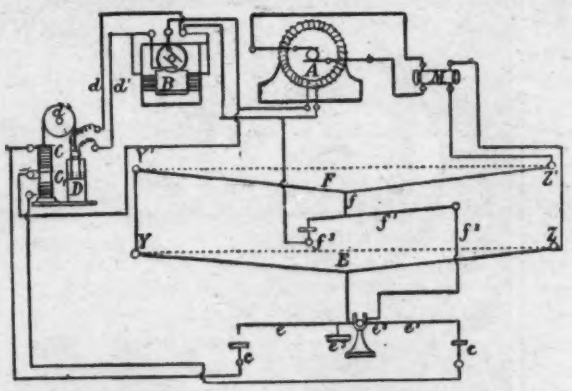


FIG. 57.—LOWRIE-HALL ELECTROMOTIVE FORCE REGULATOR

cent. of the stroke, and governs the engine speed to within two per cent. The approximate weight of each engine is 24 tons. Each engine drives its associated dynamo and alternator by means of seven cotton ropes.

Efficient means for tightening the driving ropes are provided, consisting of two cast-iron rails of heavy section, fitted at one end of each with forcing screws, provided with holding-down bolts for the dynamo, the nuts of which are of rectangular form and sliding in grooves formed in the rails; the bolts, being thus applied from above, are removable without lifting the dynamo. The two rails are securely tied together with cast-iron distance pieces. Similar arrangements are supplied for the exciter. The foundations of all the engines and dynamos below ground are built of hard gault bricks, set in Portland cement, on a continuous slab of Portland concrete. The engine floor is raised three steps above the general floor line, and each engine base set up 14 inches on a blue Staffordshire brick pedestal for conveniently reaching all the parts, and at the same time to secure natural drainage to the driving-wheel races. The floor on the raised platform is paved with blue Staffordshire bricks. All round the dynamos and exciters is a highly insulated platform of crossed floor boards set on joists, with bitumen between the two sets of boards and linoleum laid throughout. This platform is also raised six inches above the general floor line.

The boilers are the well-known Babcock and Wilcox water-tube boilers with steam drum, capable of evaporating easily 5,500 pounds of water per hour, and requiring not more than one pound of best Welsh coal per 10½ pounds of water evaporated. Daily working pressure 150 pounds per square inch. The details of each boiler are as follows:

	Feet.	Inches.
Number of tubes in each boiler, 81	—	—
Length of tubes	18	—
Diameter of tubes	—	4
Length of steam drum	23	—
Diameter of steam drum	4	—
Length of mud drum	5	6
Diameter of mud drum	1	6
Number of sections or slabs in each boiler	9	—
Total length of boiler	23	—
" height "	14	8
" breadth of all three boilers together	22	9
Heating surface on each boiler	1,790 sq. ft.	
Grate area in each boiler	33½ sq. ft.	

All joints in tubes, headers, hand-holes, etc., are metallic, no india-rubber, asbestos, or such like material being used.

*Continued from The Electrical World, Nov. 29, 1890.

The entire boiler is suspended from a gallows or supporting frame, quite independent of the brickwork, thus allowing free expansion and contraction, and the removal, if necessary, of the brickwork, without disturbing the set of the boiler or connections. The steam drum where exposed to radiation is covered two inches deep with non-conductor. The chimney shaft is common to all three boilers. Its dimensions are:

	Feet.	Inches.	
Height from base plate	100	0	above ground.
Inside diameter	5	6	
Outside diameter at base	11	0	

These dimensions are sufficient for a battery of six boilers, the intention being to erect another shaft for the second six boilers. Below ground the chimney rests on a slab of concrete, 20 feet square by six feet thick, on the red London gravel.

The boilers are connected with copper connecting pipes to a 15-inch steel main pipe (this latter being of sufficient size to supply steam from 12 boilers to 12 sets of plant), carried on brackets fixed on the side of the wall, and each engine is again connected thereto by a copper bend pipe; the connections, both to engines and boilers, are arranged so that their spring or flexibility will allow for expansion of the main steam pipe, thus dispensing with any expansion joints. The condensed water from the pipe is collected in a receiver for use in the works and for the meters. The joints of this pipe are made with rings of copper tube covered with asbestos, fitting into a small spigot and faucet formed in the flanges. The exhaust pipe, 27 inches in diameter, is also arranged to be common to all engines. It is of steel, similar to the steam pipe, the connection from the engines and to the heaters being of copper, arranged to take the expansion of the main pipe.

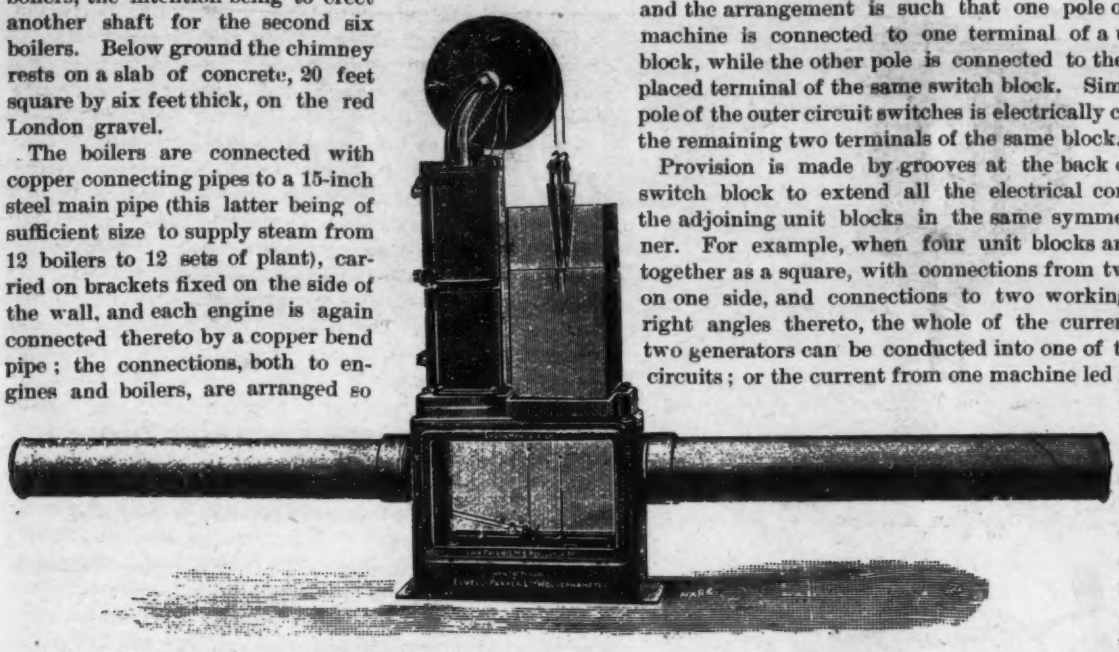


FIG. 57.—LOWRIE-HALL ELECTROMOTIVE FORCE REGULATOR.

After passing through the heaters or the by-pass provided, the exhaust steam passes into the chimney; the drain from this pipe passes into a well, under the water level. The drain pipes from the engines are also all taken to a main drain pipe common to all engines and carried to this well and under water. This well is automatically drained of surplus water and prevents steam from being blown directly into the sewers.

The high-pressure leads from the alternators are brought to a switch room and all connections, governing and changes are effected in this room. As at present arranged, each dynamo works on to a single and separate primary main. There are already about 25 miles of such main laid in the streets. The three pairs of leads from the three alternators and the ends of the three pairs of primary street mains are all brought to a switchboard, and by a simple four-plug switch any dynamo can be put into any main. The leads from each dynamo have their own double-pole safety fuses, ammeter and voltmeter. There is also a double set of synchronizing transformers for putting any pair of dynamos in parallel, as described in connection with the Leghorn central station.

The mode in which this cross connection of any dynamo to any main is made is very simple and practical.

Four straight terminals are mounted upon bosses of earthenware bolted to a slab of slate. The front earthenware bosses are deeper than the projection of the terminals from the face of the slate, to protect the terminals from dust, dirt and the like, and to prevent accidental contact. The entrance orifices of these front bosses are funnel shaped, in order to guide the plugs to their respective seats in or upon the terminals. The back ends of the latter protrude through the back earthenware bosses, to which they are secured, and the terminals are formed to receive and bind the circuit conductors. This arrangement of four terminals upon their base is termed a terminal base. Upon a similar but smaller base of non-conducting material are also secured four plugs corresponding in position to the aforesaid terminals. In the centre is a wooden or other insulated handle; a stop is fixed to limit the insertion of the plugs within the terminals. A strip of copper electrically connects each pair of plugs; and the base, with its handle and four plugs, is called a plug base. The combined four-terminal base and four-plug base is called a unit switch block.

The arrangement of the plugs, and that of their corresponding terminals, is that of a rectangle, nearly square in dimensions. This is to prevent the plug base being inserted wrongly in the terminal base, to make vertical connections (for example) instead of horizontal ones. The smoothing-iron form of the handle also serves to indicate the position in which the plug base should be held in switching, so that by the rectangular form and arrangement of the circuits it is impossible to plug the wrong terminals in a unit switch block. The terminals are made in the form of a split tube, to make spring contact upon the exterior surface of the solid plugs.

The requisite number of switch blocks are mounted upon a suitable support, in the form of a square. Upon one side of the square we connect each of the unit switch blocks to a generator, and upon a horizontal line with each of these a similar switch is placed, one for each, and connected to the working of the outer circuits.

In the respective circuits named are placed safety fuses, and the arrangement is such that one pole of a dynamo machine is connected to one terminal of a unit switch block, while the other pole is connected to the diagonally placed terminal of the same switch block. Similarly, each pole of the outer circuit switches is electrically connected to the remaining two terminals of the same block.

Provision is made by grooves at the back of each unit switch block to extend all the electrical connections to the adjoining unit blocks in the same symmetrical manner. For example, when four unit blocks are combined together as a square, with connections from two dynamos on one side, and connections to two working circuits at right angles thereto, the whole of the current from the two generators can be conducted into one of the working circuits; or the current from one machine led into one circuit, while the other machine is supplying the other circuit; or one circuit is fed by both machines, the supply of the other circuit being drawn from one machine only; or, finally, both circuits may be fed by both generators, according to the number and arrangement of the plug bases engaged with their respective terminal bases. Thus, any number of generators and circuits can be electrically connected by adding the requisite number of unit switch blocks in the manner indicated.

The next important element in the system is the self-regulating arrangement, by means of which a constant electromotive force of 2,000 volts is kept at the terminals of each dynamo. As the loss of volts in the primary mains between full load and lightest load is only two and a half per cent., no adjustment is made for varying current in the main, but the terminal pressure difference is kept constant at the machine.

This is effected by regulating the exciter current by shunting more or less of the field current of the series-wound exciters.

From the terminals of one single coil of the armature of the dynamo is taken off a pair of wires, and the 75 volts of this coil is reduced by a small transformer to 50 volts. The current from the secondary of this small transformer is passed through two horizontal fine wires like a Cardew voltmeter, and the greater or less expansion of these wires, as the E. M. F. of this coil of the armature varies, causes a greater or less sag of these wires. This expansion is then made to effect the regulation as follows:

Across the terminals of the above-mentioned transformer M are the two fine wires E and F (see Fig. 56), supported between the fixed points Z Y and Z_1 Y_1, whose normal positions when cold are shown by the dotted lines, the two wires being in series with one another, and connected by the wire, Y Y_1. The field magnets of the alternator A are excited by the exciter B. Across the fields of this exciter a shunt of varying resistance is placed, connected by the wires d d^1; this shunt resistance is formed by two metal plates dipping in the solution in the electrolytic cell D, and its resistance is altered by the raising and lowering of the plates into the solution, which is accomplished automatically by the passage of a current through either one of two solenoids or coils which pull up or down an iron core inside the coils; the top coil, C, lowers them, and the bottom coil, C_1, raises them by the attraction of this movable iron core inside the coils.

This core is attached to the plates by a cord passing over a pulley d^2. To the centre of the wire E a cord is attached, the other end of which is fixed to the arm e of the rocking arm e e^1; this arm is pivoted at e^2 on a fixed support. If the electromotive force of the dynamo rises too high, the sag becomes greater, and the arm e is pulled down by the weight e^2, and so makes contact on the table c; if, however, the electromotive force falls, the wire pulls the arm e up, so causing the other arm e^1 to make contact with the table c^1. To the centre of the wire F the cord f is attached, which raises or lowers the arm f^1, pivoted at its end, off or on to the table f^2. This table f^2 is connected to one pole of the exciter, and the pivot of the arm f^1 is connected by the wire f^2 to the pivot of the rocking arm e^2; the table c is connected to the top coil C, and the table c^1 to the bottom coil C^1, the other ends of these two coils being jointly connected to the other pole of the exciter. If now the electromotive force of the dynamo rises too high, the arm e falls, so making contact with the table c; the electromotive force of the exciter is therefore right across the coil C, one side being in metallic connection, and the other being connected through the table f^2, up the arm f^1, through the wire f^2, to arm e, so passing through the table c, connected with the coil C. This coil coming into action pulls the core up and so lowers the plates into the solution, which therefore lowers the resistance of the shunt, so causing less current to pass round the fields of the exciter and consequently weakening the field of the dynamo A, so lowering its electromotive force. These coils, C C_1, it should be mentioned, are wound with fine wire and are of high resistance, so their connection across the exciter has no effect upon the dynamo A. If, however, the electromotive force is too low, the arm e^1 touches the table c^1, so shunting the current through the coil C_1, which, coming into action, raises the plates out of the solution, and consequently the resistance of the shunt, so that more current passes from the exciter round the fields of the dynamo A, whose electromotive force therefore rises. The arm f^1 is put in to cut out the action of the regulator in the event of the wire E breaking, for that wire by breaking would stop the passage of the current through the wire F, so making the latter contract and pull up the arm f, so breaking its connection with the table f^2. If no provision is made for this accident the arm e, by making permanent contact with the table c, would lower the electromotive force of the dynamo as far as the shunt would allow. In the shunt resistance, the two plates, which are fixed to an insulating piece, dip into the solution contained in the glass cell. The plates are supported by two chains, which pass over the two ebonite wheels; these chains make connection with the plates and terminate at two terminals, having sufficient slack to allow the wheels to turn their maximum distance either way. On a smaller pulley a chain is fixed, supporting the iron core, which moves up or down in the coils; the speed of the motion of the plates is increased or decreased by the ratio of the diameters of the pulleys. The coils are wound upon a brass tube, which is filled with glycerine to act as a dash-pot, the core acting as a plunger itself. The plates in the shunt resistance cell should be changed periodically

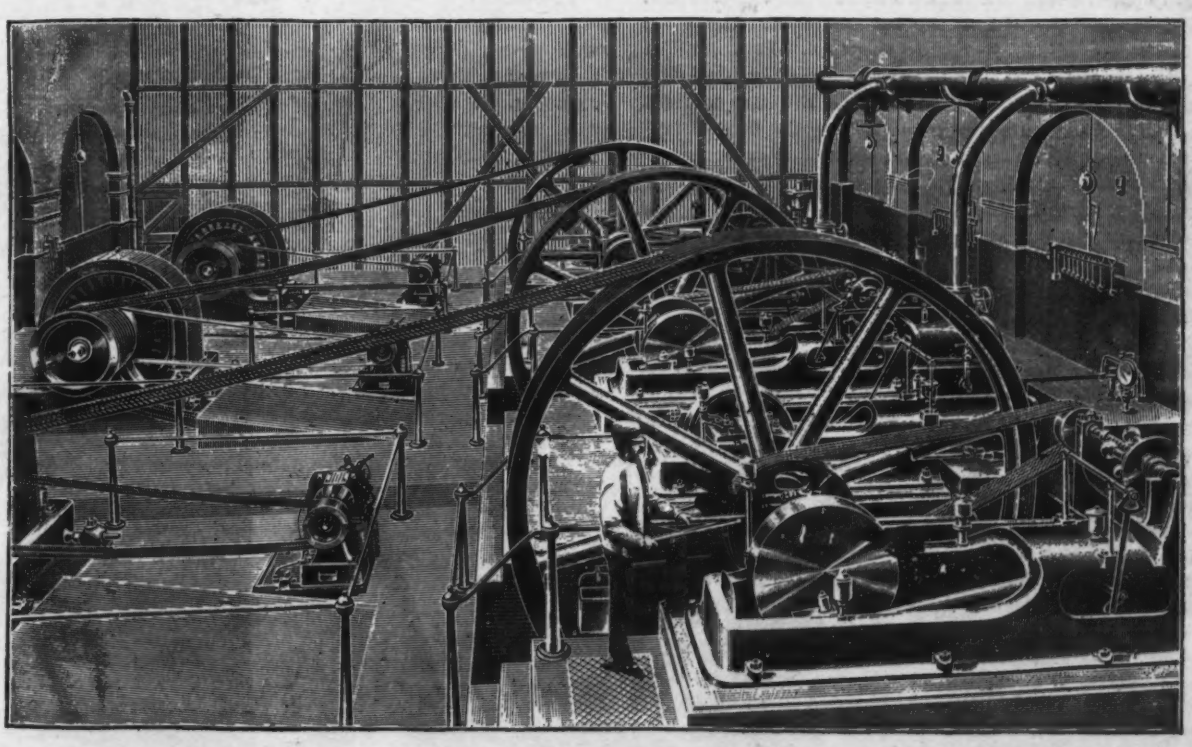


FIG. 55.—MAIN ENGINES AND ALTERNATORS IN CENTRAL STATION, WEST BROMPTON.

o reverse the chemical action of the current upon them. In the actual instrument thus designed to utilize the sag of the wire, the wires are stretched in a brass tube, in the centre of which is a containing box; at each end of the tube is a disc or insulation, on one of which are two movable brass strips to tighten the wires by the action of the thumbscrews. These are used to adjust the instrument. On each of these strips is a terminal, so that they make electrical connection to the wires. At the other end of the tube a brass piece is fixed, on to which both wires are screwed. The rocking arm is jeweled in both movements. The use of the guiding arm is to bring the centre pin on to the bridge, so that when the current ceases the wire is free from contact. All the contacts are made of platinum, and the connections to the tables are made in the terminals underneath; these tables are all adjustable from below, so that their height may be altered, without allowing cold air to get into the tube whilst the current is on. The use of the other arm as a cut-out has already been described. The use of one wire is that of a cut-out as before described. It will be seen that another method of rendering the instrument still more sensitive or the reverse is by moving the attachment of the cord on the rocking arm nearer to or farther from the pivot.

The external appearance of this regulator is shown in Fig. 57.

(To be continued.)

A Holiday Electric Outfit.

The accompanying illustration gives evidence of the fact that The E. S. Greeley & Co., while attending to the larger demands of the trade, are not neglecting to provide for the entertainment of the little folks and amateurs in the coming Christmas season.

The cut illustrates a very happy combination of battery, motor and medical coil. The battery is built under the Nowotny patents and consists of a square shell of carbon, which form one element of the battery and at the same time is the containing vessel for the fluid. Treatment of the carbon on the outside of the shell prevents all leakage. The zinc element, which is in the form of two fingers, rides upon a central shaft after the method of the Grenet battery, making a plunge battery, and all that it is necessary to do to put the battery in action is to lower the zinc and to throw the battery out of action to raise the zinc and fasten it in the raised position by means of the small clutch or screw provided for that purpose.

The ingenuity of the device is shown in the feature of the circuit breaker or commutator of the motor acting as the circuit breaker for the medical coil, so that no vibrator whatever is required upon the coil, which may be either kept in action or thrown out, as desired. The outfit is made either with the motor alone or with the motor and coil combined.

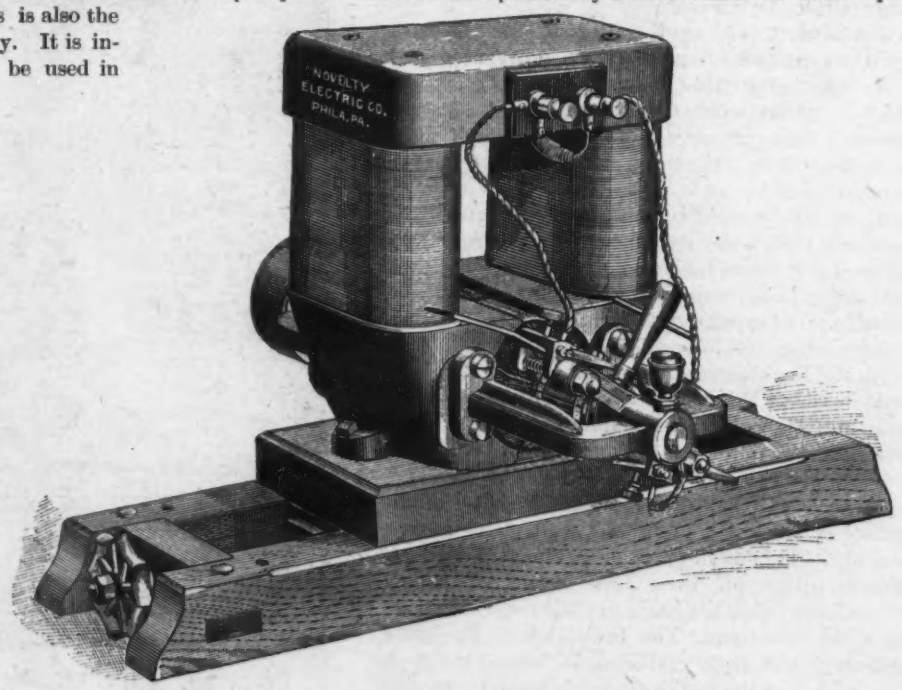
It is claimed that the battery has sufficient capacity to run the motor and coil for a period of about 12 hours at a single charging; the active solution employed being bichromate of potash. The outfit has been christened the "Holiday Motor and Coil Electric Outfit."

A HOLIDAY ELECTRICAL OUTFIT.

A New Motor and Dynamo.

We illustrate herewith a couple of new machines brought out by the Novelty Electric Company, of Philadelphia. They are respectively a half horse power constant potential motor and a 20-light dynamo. Both machines are of simple construction, and special pains has been taken to show as good workmanship on these small motors and dynamos as would be found if they were larger and more pretentious. The single magnetic circuit is used in both, the motor being of the inverted horseshoe type, while the dynamo has its field magnets nearly of the same form, but opening downward. The latter machine is intended for 110 volts at a speed of 1,800 revolutions per minute. It is plain shunt wound, but by reason of a singularly low armature resistance it is nearly self-regulating, and gives the best of results in operating incandescent lamps for small installations. All its parts are interchangeable and can be duplicated at short notice. The commutator is of phosphor bronze and is insulated, as is also the armature, very thoroughly. It is intended more especially to be used in stores, factories, mills and the like, and it is designed to furnish effective service and a reliable machine at a reasonable price. The motor is of similar construction, and, like the dynamo, has an air gap reduced to the smallest practical depths. Its commutator is made of tempered copper instead of phosphor bronze as in the dynamo, and experience has shown that its working qualities are most excellent. The parts of the machine are made to gauge and interchangeable, so that each can be immediately duplicated. The bearings are of graphite, and consequently little difficulty is experienced in obtaining satisfactory lubrication and light running. The pole pieces are so shaped as to avoid sparking even at considerable variations of load, and, altogether, the motor has shown itself capable of doing very satisfactory work in the class of service for which it is designed.

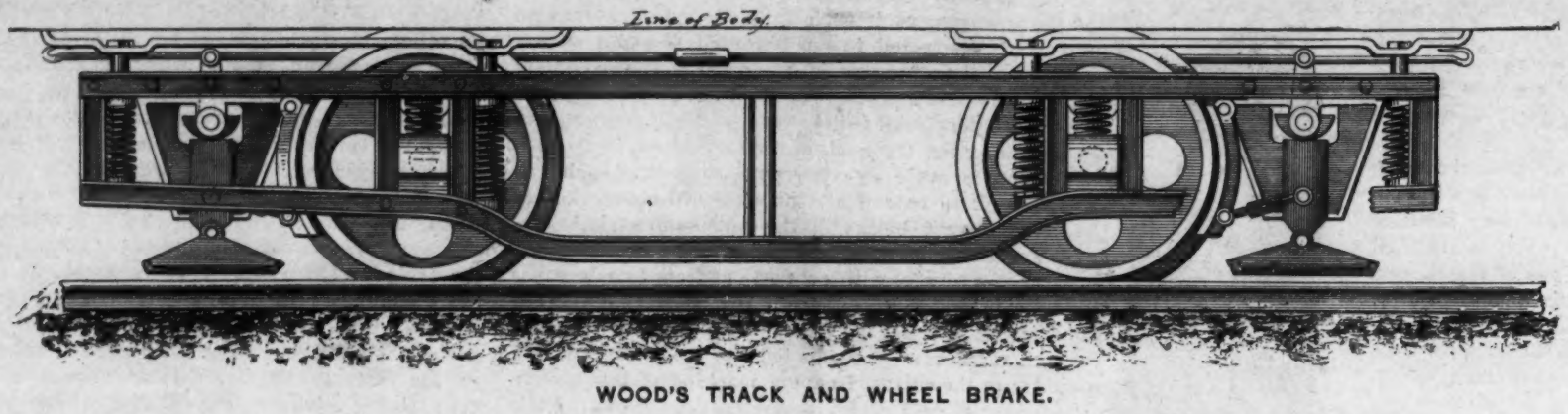
NOVELTY ELECTRIC COMPANY'S MOTOR.



DYNAMO OF THE NOVELTY ELECTRIC COMPANY.

A Combined Track and Wheel Brake.

A new "combination track and wheel brake mechanism," the invention of Dr. R. O. Wood, of Worcester, Mass., is shown in the accompanying illustration. It consists of a horizontal shaft pivotally connected to a truck frame in a position favorable to applying a brake-shoe to the track and wheel. The illustration shows the mechanism applied to an electric car truck. It may be slightly varied in construction to fit horse cars or freight or passenger cars on steam roads, as desired. To the horizontal shaft a radial arm is attached and is pivotally connected through intermediate mechanism with the draw-bar of a horse car or freight car, or to any suitable brake power mechanism operated by compressed air, steam, or electricity.



WOOD'S TRACK AND WHEEL BRAKE.

On each end of this horizontal shaft is attached a cam, which is placed directly over a vertical sliding block which is kept in close contact therewith on its lower surface by means of spiral springs, which automatically remove the brake shoes from the track and wheel when the brake power is removed and the car is again forced forward.

On the outer or inner side of the vertical sliding block is pivotally attached one end of a link fitted with a turnbuckle, and this link is connected at its opposite end to the wheel brake-shoe. It will be seen that as the cam shaft is rocked by means of the reversal of the draw-bar by which the vehicle is drawn, or by a hand crank through intermediate mechanism with the radial arm on the horizontal shaft, or link connections with an air brake power operated by the engineer—the sliding block is forced downward, carrying with it the brake-shoe to the track rail and simultaneously operates the toggle joint mechanism, whereby the other brake-shoe is forced against the periphery of the wheel.

Duplicate horizontal shafts may be placed in position on truck frames of freight or passenger cars, by means of which four, eight or more track brakes may be applied to the rail simultaneously, and all operated by link connections, with supplementary radial arms on the central horizontal shaft operated by a hand crank or other operating mechanism. The frictional surface presented by such a brake power mechanism must decrease the speed of a train of cars very suddenly when an emergency demands it, or it may be applied less forcibly at the will of the brakeman or engineer.

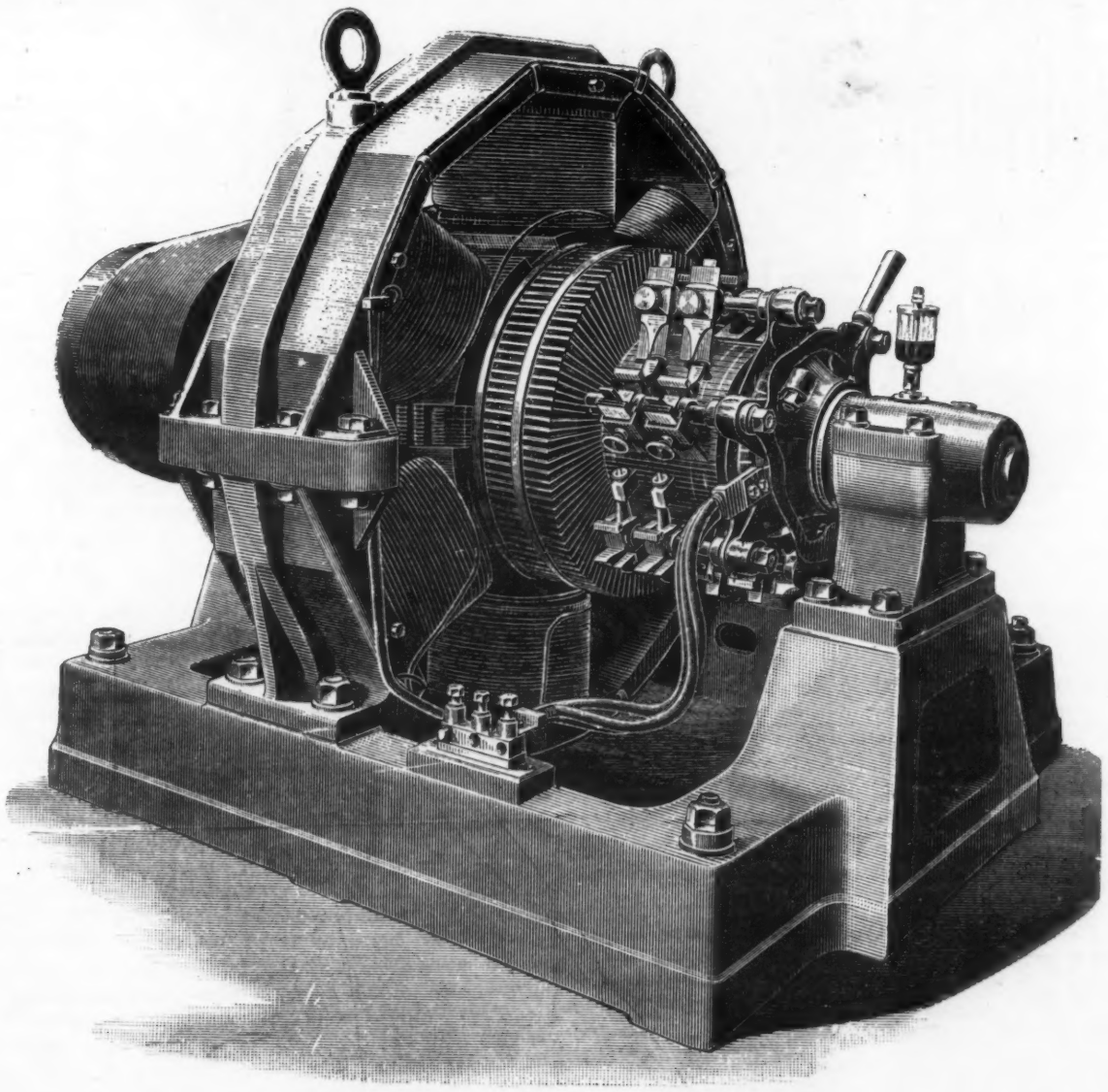
Life of Series Incandescent Lamps.

Mr. Frank Lott, writing to the London *Electrical Engineer* upon this subject, says: "In the discussion on Mr. Bernstein's paper on the 'Series System,' read in the Institution of Electrical Engineers in 1886, Mr. Mordey expressed the opinion that lamps on a circuit of constant current must of necessity be shorter lived than lamps on a parallel circuit, the reason being that the resistance of lamps rises in course of time. If placed in parallel they will then

take less current, give less light, but have a considerable preservative power. This view appears very plausible, and it will therefore be of interest to many readers to hear that a Bernstein lamp, which was placed on a circuit of constant current of 10 ampères in Niagara in London, has been in use more than three years every night except Sundays, and has already lasted more than 10,000 hours. During the present year it has been run 12 hours daily. The system on which this lamp has been run is known as the Wood system of arc lighting, and is owned by the Fort Wayne Electric Company, of Indiana."

Kapp's Central Station Dynamos.*

The accompanying illustration represents a new type of multipolar dynamo machines manufactured by Messrs. Johnson and Phillips to the design of Mr. Gisbert Kapp. The increase in the number of poles beyond two offers several advantages for large machines which are required to run at a comparatively low speed, among which the most important is the reduction of armature reaction. If an attempt be made to increase the power of machines by simply increasing the linear dimensions of the ordinary bi-polar type a limit is soon reached where the magnetic effect of the armature itself begins to become objectionable, not only because it causes a certain reduction in the terminal pressure but also—and this is the most serious drawback—because it necessitates altering the lead of the brushes if the current varies and causes liability to sparking at the commutator. Other advantages of the multipolar type of dynamo as compared with the ordinary bi-polar type are increased efficiency and decreased weight with a corresponding decrease in the cost of manufacture. The particular machine we now illustrate is designed for a speed of 450 revolutions per minute, and an output of 1,000 ampères at 50 volts terminal pressure; but the same armature winding with a slight modification in the end connections, to be presently described, serves for an output of 330 ampères at 150 volts terminal pressure. The armature core consists of soft iron discs and is 24 inches external diameter by 12 inches long. It is provided with driving horns and ventilated very much in the same manner as that adopted in the two-pole Kapp machines, but its large internal diameter renders this ventilation specially efficient, so that

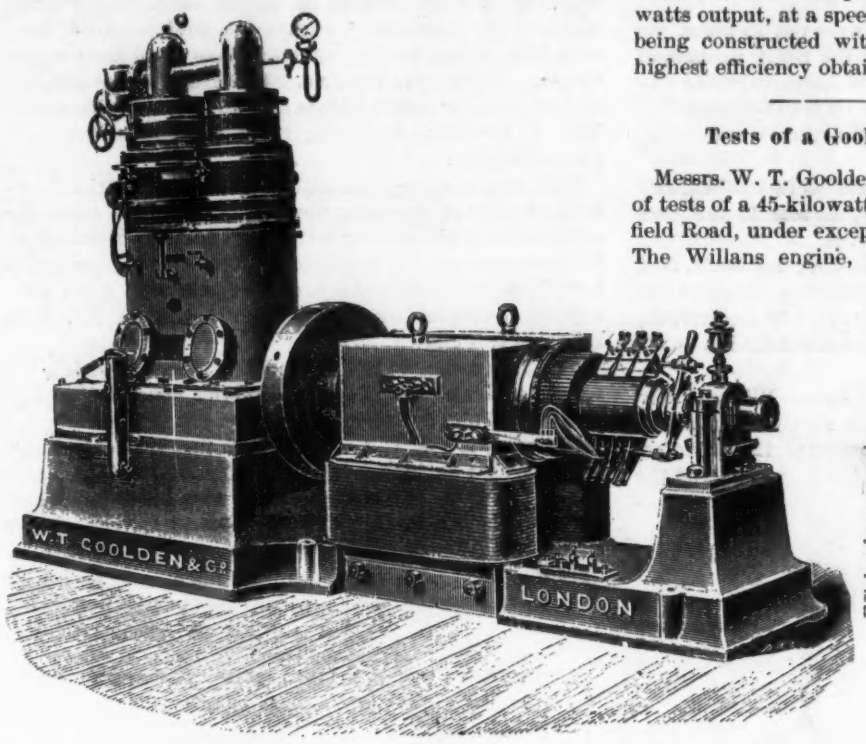


KAPP'S NEW CENTRAL STATION DYNAMO.

the rise of temperature is smaller than generally allowed in two-pole machines. The field system consists of six cylindrical magnet cores placed radially and joined at their outer ends by a yoke, while the inner ends are provided with pole shoes. The exciting coils, which form a shunt, are placed upon the radial portions of the magnetic system. The field consists entirely of cast iron, and could be made in one single casting; but in order to facilitate the insertion of the armature the casting is in two parts, divided horizontally, so that the top half may be lifted off and the armature lowered into the machine from above, instead of being slid in horizontally, as has to be done in two-pole machines, often at the risk of injuring the winding.

The armature is covered by 224 copper bars, the ends of which are joined to form what is known as a multipolar parallel drum winding. The joining pieces or end connectors consist of flat copper segments, embracing an angle of 60 degrees. These connectors are provided at either extremity with tags bent at right angles to the plane of the segment, and the latter, after being insulated, are arranged spirally round a cast-iron sleeve or flanged pulley, which is bolted to the armature core, or rather to the cast-iron rings, between which the armature core is held. Thus at either end of the armature core there is a connector, the different plates of which terminate in tags above mentioned, and these tags form circular rows or projections in a convenient position to engage into and be joined with the ends of the armature bars by riveting and soldering. For parallel winding the connection is made forward at one end and backward at the other end of the armature, whilst for series winding the connection is made forwards as both ends. In the latter case the current splits into two branches only in passing through the armature, and only two sets of brushes, placed diametrically opposite, are required. For parallel winding, which is the winding actually adopted in the machine we illustrate, six sets of brushes placed 60 degrees apart are required. The resistance of the armature is .0015 ohm, causing a loss of 1.5 volt at full output. The total weight of the machine is 76 hundred weight, and eleven machines of the same type, but of larger size, for a central station are being built. We learn also that an experimental machine to give 125 kilowatts output, at a speed of 132 revolutions per minute, is being constructed with the object of ascertaining the highest efficiency obtainable with very slow speeds.

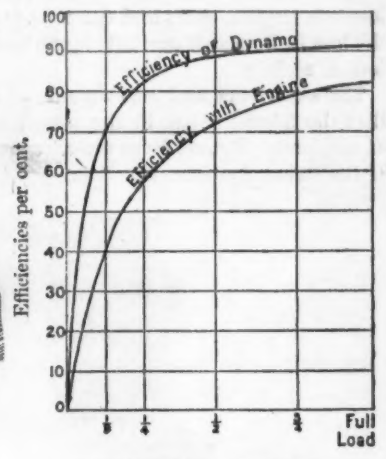
*From *The Engineer*, London.



GOOLDEN DYNAMO AND WILLANS ENGINE.

Tests of a Goolden-Willans Combination.*

Messrs. W. T. Goolden & Co. have recently made a series of tests of a 45-kilowatt dynamo, at their works in Woodfield Road, under exceptionally interesting circumstances. The Willans engine, which was destined to drive the machine, was delivered to the dynamo makers, instead of the more usual reversed custom, and, being ready for running, the tests were made during the building of the dynamo, thus enabling measurements of the various losses to be made as the different portions were put together. We are not aware that any such tests have been previously made, and, at all events, none have hitherto been published in such detail. The tests were made under several disadvantages; the engine and dynamo were quite new, and hence the mechanical efficiency, though high, is not as high as has been actually shown by later measurements, when the combination had been running a short time, and the journals had taken a fair bearing. The loss in the core was also probably augmented to no small extent by the fact that this dynamo was originally designed for 105 volts, but the field excitation was raised to give 125 volts at the original speed, the induction being thus somewhat wastefully increased, and the leakage through the shaft and spider causing eddy currents and loss being intensified.



EFFICIENCY CURVES.

The dynamo is one of a number which are being made for the station at St. John's Wharf, of the Westminster Electric Supply Corporation, whose stations were described in a recent issue. The arrangement of the dynamo differs from the well-known Willans combination bed plate, which is so largely adopted by the Admiralty, in the substitution of the well-known *overtype* pattern of dynamos for the *undertype*. Messrs. Goolden's reason for this is, that they consider that for dynamos up to, say, 50 kilowatts, the greater accessibility of the brushes and ready removal of the armature more than compensate for any advantage to be gained by keeping the shaft lower.

The dynamo itself has wrought iron field magnets, bored to receive the armature. The lower pole horn is of cast iron, an arrangement suggested by Mr. Essen in his paper to the Institution of Electrical Engineers last year, but previously in use by Messrs. Goolden & Co. The objection usually raised to overtype dynamos, that of the extra pull downward, is met by an increased clearance being given on the lower side, so that the pressure on the outer bearing, which, when the dynamo is unexcited, amounts to nine hundredweight, diminishes to eight and one-half hundredweight when the magnets are excited. The outer end bearing is mounted in a spherical bed or seating, so as to automatically line itself in the event of the unequal wearing of the different bearings causing any twist to be thrown on the shaft.

The armature is a bar armature, the bars being laminated. The ends are Messrs. Goolden's "solid built," that is, they are composed of radial V-shaped strips, built up and insulated with mica after the manner of a commutator, thus presenting a completely solid end and preventing the ingress of dirt or wet. The field magnet coils have internal ventilating space and outlets for the air. It will be noticed that all the electrical and mechanical sources of loss, except that in the armature coils, have been taken as constant at different loads. This is not theoretically correct, but the assumption is well within the limits of experimental error. The friction on the journals of the engine no doubt increases with a heavier pressure, but the principal friction is that of the pistons and valves, and this is constant. The friction of the shaft probably decreases slightly, and the

*From *The Electrician*, London.

eddy currents in the core are diminished, at heavy loads, by the demagnetizing effects of the armature current.

The electrical data are as follows: Volts, 120; ampères, 375; watts, 45,000; speed, 440; armature resistance, .013; resistance of field-magnet coils, 21.4 ohms.

INDICATOR TESTS OF GOOLDEN-WILLANS COMBINATION.

1. The engine was run with the armature disconnected. and found to absorb 8.43 indicated horse power when running light at 430 revolutions.

2. The armature shaft and core were put in place, no windings being on, and running with the fields unexcited; 9.92 indicated horse power was recorded, equivalent to 1.49 indicated horse power for the shaft. (It is to be noted that this is excessive, as the bearing at the time was running hot.)

3 The core only being in, the fields were excited, and 11.56 indicated horse power recorded, the loss in the core being thus 1.64 indicated horse power.

4. The armature was wound and another test made, first unexcited, then excited, and deducting the value for the losses in engine, shaft and the core, previously ascertained, the loss in Foucault currents in the bars was found to be .34 indicated h. p.

The experience and experiments of Messrs. Willans show that the frictional loss in the engine is nearly independent of the load. Hence, from the above figures, the efficiency of the steam dynamo can be given for any load, and the commercial efficiency of the dynamo calculated for any output.

FIG. 2.—LAMP RHEOSTAT.

The table below shows the results tabulated by Messrs. Goolden & Co., together with additions which we have made from calculations based upon the above data, it being noted that the loss in the shaft friction has been taken at .39 indicated h. p. (This value was found to represent an average in later tests, the above value being exceptional owing to the circumstance mentioned; but the individual test being for a difference, this was unimportant).

COMMERCIAL EFFICIENCY OF DYNAMO AND OF COMBINATION.

Proportion of full load.	Indicated Horse-Power Reduced to Watts. Loss in engine.	Loss in shaft	Loss in core.	Loss in bars, eddy current.	Loss in armature ($c^2 r$).	Loss in magnet coils.	Total loss in dynamos	Total loss in dynamo and engine.	Dynamo losses per cent.	Total losses per cent.	Output in Watts. Volts	Ampères	Watts.	Efficiency. Commercial efficiency of dynamo.	Commercial efficiency of combination.
1	6,300	290	1,220	254	1,820	660	4,244	10,544	9.4	23.4	120	375	45,000	91.2	81
½	6,300	290	1,220	254	520	660	2,944	9,244	12 25	38 4	120	200	24,000	89.1	72.2
¼	6,300	290	1,220	254	130	660	2,554	8,854	21.2	73.6	120	100	12,000	82.5	57.5
⅛	6,300	290	1,220	254	32.5	660	2,456.5	8,756	41	146	120	50	6,000	71	40.6
1/16	6,300	290	1,220	254	8	660	2,432	8,732	81	290	120	25	3,000	55.3	25.6
0	6,300	290	1,220	254	0	660	2,124	8,724	∞	∞	120	0	0	0	0

These calculations accord well with direct indicator tests. The dynamo giving 43,400 watts, the efficiency as indicated was 80.4 per cent.; and, when giving 26,500 watts, the efficiency was 72 per cent.

Independent tests of these dynamos and engines, at the station supplying current to the Houses of Parliament, have been since made by Prof. A. Kennedy, consulting engineer to the Westminster Electric Corporation, giving even better results than the above, the commercial efficiency in some tests reaching as high as 85 per cent. and 86 per cent., but as further tests are being carried out on the same machines the results are not yet complete.

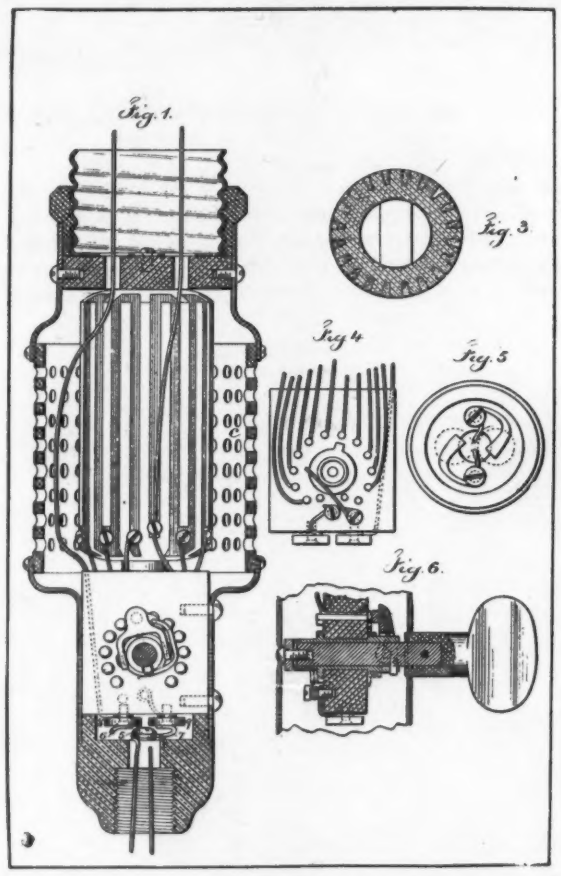
A Lamp Socket Rheostat.

The users of incandescent lights have often asked, "Can you not furnish us a light which is capable of being turned down just as gas is, so that in case we do not require the full candle power of the lamp the light may be partially or almost wholly turned off?" With alternating current distribution this is made possible by the use of various appliances which it is not our purpose to discuss here, but for lamps supplied by continuous currents the devices which have been brought out for this purpose have been more or less deficient in various respects. Some are large and unwieldy, or are of such a nature that an excessive amount of heat is developed, rendering them useless in actual commercial service.

The accompanying illustrations show a remarkably ingenious piece of apparatus devised for use with either the continuous or alternating current systems of distribution. In its design many of the difficulties heretofore experienced have been overcome and it is constructed in a form suitable for commercial use. It is the invention of Mr. John Doyle, of this city.

Fig. 2 shows the completed socket. Fig. 1, which is the section of this socket, shows its interior construction and Figs. 3, 4, 5 and 6 represent minor details.

Referring to Fig. 1, it will be seen that the central part of the socket is inclosed in a perforated cylinder, also shown in Fig. 2, which is made of some insulating material, either hard rubber or fibre. At either end of this a flanged tube is attached by screws. One of these contains a socket for the lamp, the other encloses the switch by means of which the lamp is turned up or down as desired.



FIGS. 1, 3, 4, 5 AND 6.—LAMP RHEOSTAT.

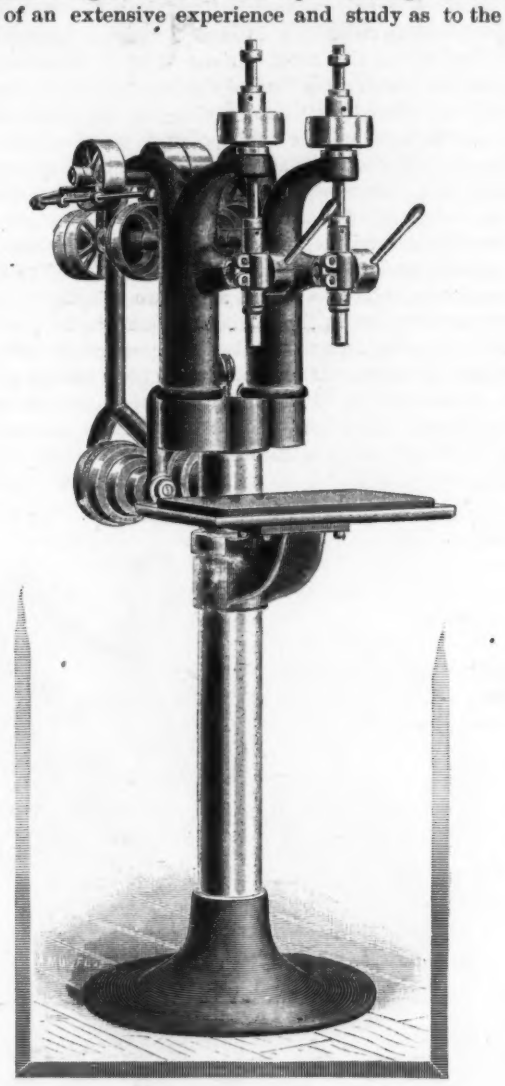
The resistance cylinder shown in the central part of Fig. 1 and the insulating switchblock are connected together in any desired manner. The resistance cylinder is composed of a non-conducting material, preferably pipe clay and retort cement mixed in any desired proportions into a paste and molded in a cylindrical form and baked or otherwise hardened, with longitudinal grooves in its outer surface, these grooves being connected at alternate ends of the cylinder. The resisting material, which consists of plumbago and borax, or other equivalent, mixed together, is inserted in the longitudinal grooves and the end grooves that connect these, thus forming a zig zag line of resisting material on the surface of the non-conducting cylinder.

A suitable switch is provided, which is shown in Fig. 6, and also shown diagramatically in Fig. 1, by means of which more or less resistance may be connected in series with the filament of the lamp. For this purpose the switch is provided with about ten contact points, which are connected, as shown in Fig. 1, to different parts of the resisting material, so that it is possible to secure about ten degrees of illumination.

It will be seen that this rheostat is in the most compact form possible, and in this form is well suited for use in actual service. Mr. Doyle has overcome, to a very large extent, the objections which might be raised against a rheostat on the ground that an excessive amount of heat would be developed by its use. Even when the switch is so placed that the entire amount of resistance is in circuit, and the light is burning with the lowest illumination possible, the amount of heat developed after an hour's burning is not so great as to render the socket unbearably warm, so that it will be seen that the loss through heat waste has been reduced to a minimum. We have seen Mr. Doyle's lamp placed in circuit with a sensitive Walker meter, and each of the ten steps from full candle power down to merely a dull red filament showed a reduction of at least one-half in the amount of current passing through the lamp, while the heat waste was much smaller than might be supposed.

A Drill for Light Work.

The Norton drill as shown on this page is designed for all classes of light, sensitive and rapid drilling, and is the result of an extensive experience and study as to the requirements of a drill of this class, embodying many new and original improvements of considerable importance. In capacity it is adapted for drilling all classes of holes up to one-half inch, and to the centre of 12 inches, being six and one-eighth from face of column to centre of spindle. In depth, it will drill without readjustment of table or work, four inches, this being the amount of motion of the spindle. In height it will admit work from 30 to 33 inches.



NORTON DRILL.

As a centering machine it will drill and ream all classes of shafts to 30 inches length, and will be found even more convenient than many of the special machines for this purpose. Each drill is provided with a bell centre for insertion in the table to receive the lower end of shaft to be centered, there being an index line on the column to insure its perfect line with the spindle. The drill is very sensitive, the spindle being balanced by a special coiled spring, so arranged as to secure a perfect balance, and is provided with an adjustment for use when chucks or other tools are attached to the spindle.

This drill, which is manufactured by the Norton & Jones Machine Tool Works at Plainville, Conn., is a neat, handy and substantial tool. Among its prominent features it may be mentioned that it is self-contained, needs no countershaft, can be belted direct from main or other line of shafting, has no twisted belt, is powerful, sensitive, accurate and durable. It runs at a speed of 450 revolutions for general work and weighs but 275 pounds.

Tools of this kind, which are tolerably compact, easily controlled, and require but a small amount of power to operate them, will prove of great value in small repair shops connected with electric light plants, electric street railway power stations, and similar places where a great variety of work must be done, most of it of a light character, and often by inexperienced workmen.

The Electromagnet.*

BY PROF. SILVANUS P. THOMPSON, D. SC., B. A., M. I. E. E.

DIFFERENTIAL COIL-AND-PLUNGER.

There is a third drawing here, showing the arrangement which was originally introduced by Siemens, wherein a main plunger is drawn at one end into the coil that is in the circuit, and at the other end into a coil that is in shunt. That differential arrangement has certain peculiar properties of which I must not now stop to speak in detail. It is obvious that where one core plunges its opposite ends into two coils, the magnetization will depend on both coils, and the resultant pull will not be simply the difference between the pull of the two coils acting each separately. There is, however, another differential arrangement, used in the

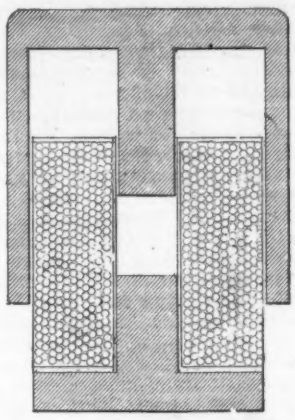


FIG. 65.—PLUNGER ELECTROMAGNET OF STEVENS AND HARDY.

Brockie-Pell and other arc lamps, in which there are two separate plungers attached to the two ends of a *see-saw* lever. In this case the two magnetizing actions are separate. In a third differential arrangement there is but one plunger and one tubular bobbin, upon which are wound the two coils, differentially, so that the action on the plunger is simply due to the difference between the ampère turns circulating in the two separate wires.

COIL-AND-PLUNGER COIL.

When one abandons iron altogether, and merely uses two tubular coils, one of wide diameter and another of narrower diameter, capable of entering into the former, and passes electric currents through both of them, if the currents are circulating in the same fashion through both of them they will be drawing into one another. This arrangement has also been used in arc lamps. The parallel currents attract one another inversely, not as the square of the distance, but approximately as the distance. This is one of those little details about which it is as well to be clear. About once a year some kind friend from a distance writes to me pointing out a little slip that they say occurs in my book on electricity, in the passage where I am speaking about the attraction of parallel wires. I have made the terrible blunder of leaving out the word square; for I say the attraction varies inversely as the distance, and my readers are kind enough to correct me. Now when I wrote that passage I considered carefully what I had to write, and the attraction does not vary inversely as the square of the distance, because two parallel wires do not act on one another as two points. They act as two straight lines or two parallel lines, and the attraction between two parallel lines of current, or two parallel lines of magnetism, or two parallel lines of anything else

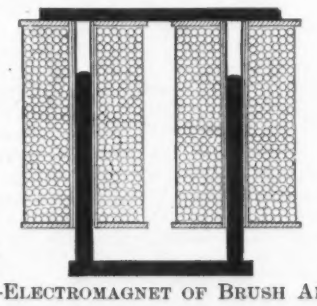


FIG. 66.—ELECTROMAGNET OF BRUSH ARC LAMP.

that can attract, will not act inversely as the square, but simply inversely as the distance in between.

INTERMEDIATE FORMS.

Now this property of the coil-and-plunger of extending the range of action has been adopted in various ways by inventors whose object was to try and make electromagnets with a sort of intermediate range. For certain purposes it is desirable to construct an electromagnet which, while having the powerful pull of the electromagnet, should have over its limited range of action a more equable pull, resembling in this repect the equalizing of range of the coil-and-plunger. Some of these intermediate forms of apparatus are shown in the following diagrams. Here (Fig. 65) is a peculiar form of electromagnet; it combines some of the features of the ironclad electromagnet with those of the movable plunger; it has a limited range of action, but is of great power over that range, owing to its excellent magnetic circuit. It was invented in 1870 by Stevens and Hardy for use in an electric motor for running sewing machines. A very similar form is used in Weston's arc lamp. A form of plunger electromagnet invented by Holroyd Smith in 1877 resembles Fig. 65 inverted, the coil being surrounded by an iron jacket, while a plunger furnished at the top with an iron disc descends down the central tube to meet the iron at the bottom.

Then there is another variety, of which I was able to show an example last week by the kindness of the Brush Company, namely, the plunger electromagnet employed in the Brush arc lamps. A couple of tubular coils receive each an iron plunger, connected together by a yoke; while above, the magnetic circuit is partially completed by the sheet of iron which forms part of the inclosing box. You have here, also, the advantage of a fairly complete magnetic circuit, together with a comparatively long travel of the plunger and coil. It is a fair compromise between the two ways of working. The pull is not, however, in any of these forms, equal all along the whole range of travel; it increases as the magnetic circuit becomes more complete.

There are several other intermediate forms. For example, one inventor, Gaiser, employs a horseshoe electromagnet, the cores of which protrude a good distance beyond the coils, and for an armature he employs a piece of sheet iron, bent round so as to make at its ends two tubes, which enclose the poles, and are drawn down over them. Contrast with this design one of much earlier date by an engineer,

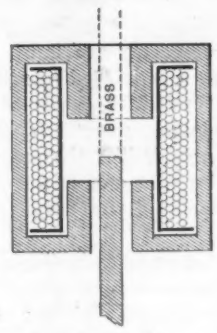


FIG. 67.—AYRTON AND PERRY'S TUBULAR IRONCLAD ELECTROMAGNET.

Roloff, who made his electromagnets with iron cores not standing out, but sunk below the level of the ends of the coils, while the armature was furnished with little extensions that passed down into these projecting tubular ends of the coils. Some arc lamps have magnets of precisely that form, with a short plunger entering a tubular coil, and met half-way down by a short fixed core inside the tube.

Here (Fig. 67) is one form of tubular ironclad electromagnet that deserves a little more attention, being the one used by Messrs. Ayrton and Perry in 1882; a coil has an iron jacket round it, and also an annular iron disc

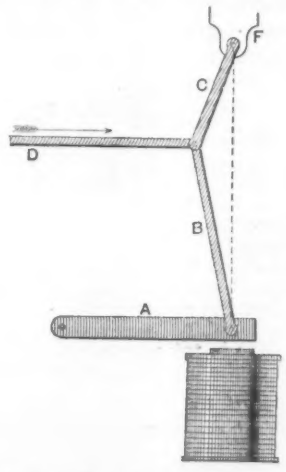


FIG. 68.—FROMENT'S EQUALIZER WITH STANHOPE LEVER.

across the bottom, there being also a short internal tube of iron extending a little way down from the top, almost meeting another short internal tube of iron coming up from the bottom. The magnetic effect of the inclosed copper coil is concentrated within an extremely short space, between the ends of the internal tubes, where there is a wonderfully strong uniform field. The range of action you can alter just as you please in the construction by shortening or lengthening the internal tubes. An iron rod inserted below is drawn with great power and equality of pull over the range from one end to the other of these internal tubes.

ACTION OF MAGNETIC FIELD ON SMALL IRON SPHERE.

In dealing with the action of tubular coils upon iron cores, I showed how, when a very short core is placed in a uniform magnetic field, it is not drawn in either direction. The most extreme case is where a small sphere of soft iron is employed. Such a sphere, if placed in even the most powerful magnetic field, does not tend to move in any direction if the field is truly uniform. If the field is not uniform, then the iron sphere always tends to move from the place where the field is weak to a place where the field is stronger. A ball of bismuth or one of copper tends, on the contrary, to move from a place where the field is strong to a place where the field is weaker. This is the explanation of the actions called "dia-magnetic," which were at one time erroneously attributed to a supposed dia-magnetic polarity opposite in kind to the ordinary magnetic polarity. A simple way of stating the facts is to say that a small sphere of iron tends to move up the *slope* of a magnetic field, with a force proportional to that slope; whilst (in air) a sphere of bismuth or one of copper tends, with a feeble force, to move down that slope. Any small piece of soft iron—a short cylinder, for example—shows the same kind of behavior as a small sphere. In some of Ayrton and Perry's coiled-ribbon ampèremeters and voltmeters, and in some of Sir William Thomson's current-meters, this principle is applied.

SECTIONED COILS, WITH PLUNGER.

An important suggestion was made by Page, about 1850, when he designed a form of coil-and-plunger having a travel of indefinitely long range. The coiled tube instead of consisting merely of one coil, excited simultaneously throughout its whole length by the current, was constructed

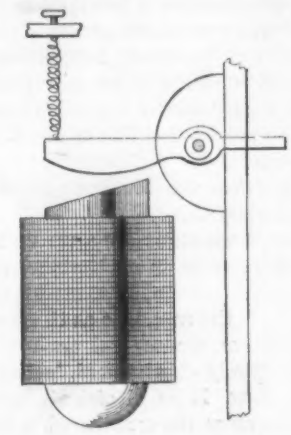


FIG. 69.—DAVY'S MODE OF CONTROLLING ARMATURE BY SPRING.

in a number of separate sections or short tubes, associated together end to end, and furnished with means for turning on the electric current into any of the sections separately. Suppose an iron core to be just entering into any section, the current is turned on in that section, and as the end of the core passes through it the current is then turned on in the section next ahead. In this way an attraction may be kept up along a tube of indefinite length. Page constructed an electric motor on this plan, which was later revived by Du Moncel, and again by Marcel Deprez in his electric "hammer."

WINDING OF TUBULAR COILS AND ELECTROMAGNETS.

The mention of this mode of winding in sections leads me to say a few final words about winding in general. All ordinary coils, whether tubular or provided with fixed cores, are wound in layers of alternate right-handed and left-handed spirals. In a preceding lecture I mentioned the mistaken notion, now disproved, that there is any gain in making all the spirals right-handed or all left-handed. For one particular case there is an advantage in winding a coil in sections; that is to say, in placing partitions or *cloisons* at intervals along the bobbin, and winding the wire so as to fill up each of the successive spaces between the partitions before passing on from one space to the next. The case in which this construction is advantageous is the unusual case of coils that are to be used with currents supplied at very high potentials. For when currents are supplied at very high potentials there is a very great tension* exerted on the insulating material, tending to pierce it with a

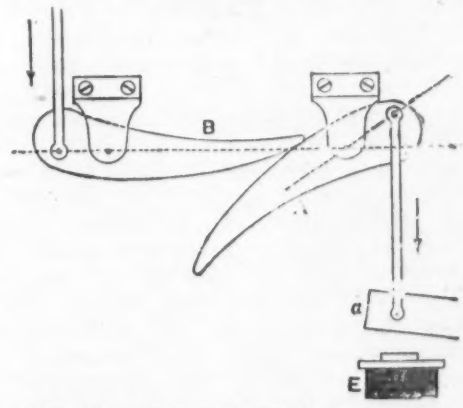


FIG. 70.—ROBERT HOUDIN'S EQUALIZER.

spark. By winding a coil in *cloisons*, however, there is never so great a difference of potentials between the windings on two adjacent layers as there would be if the layers were wound from end to end of the whole length of coil. Consequently, there is never so great a tension on the insulating material between the layers, and a coil so wound is less likely to be injured by the occurrence of a spark.

Another variety of winding has been suggested, namely, to employ in the coils a wire of graduated thickness. It has been shown by Sir William Thomson to be advantageous in the construction of coils of galvanometers to use for the inner coils of small diameter a thin wire; then, as the diameter of the windings increases, a thicker wire; the thickest wire being used on the outermost layers; the gauge being thus proportioned to the diameter of the windings. But it by no means follows that the plan of using *graded wire*, which is satisfactory for galvanom-

*Cantor Lectures, No. 4, continued from THE ELECTRICAL WORLD, Nov. 29, 1889.

*The tension on the insulating material, tending to pierce it with a spark, is proportional to the square of the difference of potentials (per unit thickness) to which the insulating material is subject. It is incorrect to talk about the tension of the conductor, or about the tension of the current; for the tension or electric stress is always an action affecting the di-electric or insulating material.

eter coils, is necessarily good for electromagnets. In designing electromagnets it is necessary to consider the means of getting rid of heat; and it is obvious that the outer layers are those which are in the most favorable position for getting rid of this heat. Experience shows that the under layers of coils of electromagnets always attain a higher temperature than those at the surface. If, therefore, the inner layers were to be wound with finer wire, offering higher resistance, and generating more heat than the outer layers, this tendency to over-heating would be still more accentuated. Indeed, it would seem wise rather to reverse the galvanometer plan, and wind electromagnets with wires that are stouter on the inner layers and finer on the outer layers.

Yet another mode of winding is to employ several wires united in parallel, a separate wire being used for each layer, their anterior extremities being all soldered together at one end of the coil, and their posterior extremities being all soldered together at the other. Magnetically, this mode of winding presents not the slightest advantage over winding with a single stout wire of equivalent section. But it has lately been discovered that this mode of winding with *multiple wire* possesses one incidental advantage, namely that its use diminishes the tendency to sparking which occurs at break of circuit.

EXTENSION OF RANGE BY OBLIQUE APPROACH.

I now pass to the means which have been suggested for extending the range of motion, or of modifying its amount at different parts of the range, so as to equalize the very unequable pull. There are several such devices, some electrical, others purely mechanical, others electro-mechanical. First, there is an electrical method. André proposed that, as soon as the armature has begun to move nearer, and comes to the place where it is attracted more strongly, it is automatically to make a contact, which will shunt off part of the current and make the magnetism less powerful. Burnett proposed another means; a number of separate electromagnets acting on one armature, but as the latter approached these electromagnets were one after the other cut out of the circuit. I need not say the advantages of that method are very hypothetical. Then there is another method which has been used many times with very great success, the method of allowing the motion of the armature to occur obliquely, it being mechanically constrained so as to move past, instead of towards the pole. When the armature is pulled thus obliquely, the pull will be distributed over a definite wider range. Here is a little motor made on that very plan. A number of pieces of iron set on the periphery of a wheel are successively attracted up sideways. An automatic device breaks the circuit as every piece of iron comes near, just at the moment when it gets over the poles, and the current being cut off, it flies on beyond and another piece comes up, is also attracted in the same way, and then allowed to pass. A large number of toy motors have been made from time to time on this plan. I believe Wheatstone was the first to devise the method of oblique approach about the year 1841. He made many little electromagnetic motors, the armatures of which were in some cases solid rims of iron arranged as a sort of wheel, with two or more zigzag internal teeth, offering oblique surfaces to the attraction of an electromagnet. Such little motors are often now used for spinning Geissler's vacuum tubes. In these motors the iron rim is fixed, and the electromagnet rotates. The pole of the electromagnet finds itself a certain distance away from the iron ring; it tries to get nearer. The only way it can get nearer is by swinging round, and so it gradually approaches, and as it approaches the place where it is nearest to the internal projection of the rim the current is cut off, and it swings further. This mode may be likened to a cam in a mechanical movement. It is, in fact, nothing else than an *electromagnetic cam*. There are other devices too, which are more like electromagnetic *linkages*. If you curve the poles or shape them out, you may obtain actions which are like that of a wedge on an inclined plane. There is an electromagnet in one of Paterson and Cooper's arc lamps wherein the pole-piece, coming out below the magnet, has a very peculiar shape, and the armature is so pivoted with respect to the magnet, that as the armature approaches the core as a whole its surface recedes from that of the pole-piece, the effect being that the pull is equalized over a considerable range of motion. There is a somewhat similar device in De Puydt's pattern of arc lamp.

Here is another device for oblique approach, made by Froment. In the gap in the circuit of the magnet a sort of iron wedge is put in, which is not attracted squarely to either face, but comes in laterally between guides. Another of Froment's equalizers, or distributors, consists of a parallel motion attachment for the armature, so that oblique approach may take place, without actual contact. Here, Fig. 68, is another mechanical method of equalizing devised by Froment, and used by Le Roux. You know the Stanhope lever, the object of which is to transform a weak force along a considerable range into a powerful force of short range. Here we use it backwards. The armature itself, which is attracted with a powerful force of short range, is attached to the lower end of the Stanhope lever, and the arm attached to the knee of the lever will deliver a distributed force over quite a different range. One way, not of equalizing the actual motion over the range, but of counterbalancing the variable attractive force, is to employ a spring instead of gravity to control the armature. So far back as 1838, Edward Davy, in one of his telegraphic patents, described the use of a spring (Fig. 69) to hold back the armature. Davy preceded Morse in the use of a spring to pull back the armature. There is a way of making a spring act against an armature more stiffly as the pull gets greater. In this method there is a spring with various set screws set up against it, and which come into action at different ranges, so as to alter the stiffness of the spring, making it virtually stiffer as the armature approaches the poles. Yet another method is to employ, as the famous conjurer Robert Houdin did, a rocking lever. Fig. 70 depicts one of Robert Houdin's equalizers. The pull of the electromagnet on the armature acts on a curved lever which works against a second one, the point of application of force between the one and the other altering with their position. When the armature is far away from the pole, the leverage of the first lever on the second lever is great. When the armature gets near, the leverage of the first lever on the second is comparatively small. This employment of the *rocking lever* was adopted from Houdin by Duboscq, and put into the Duboscq arc lamp, where the regulating mechanism at the bottom of the lamp contains a rocking lever. Here upon the lecture table is a Duboscq arc lamp. In this pattern (Fig. 71), one lever *B*, which is curved, plays against another, *A*, which is straight. A similar mechanism is used for equalizing the action in the Serrin arc lamp, where one of the springs that holds up the jointed parallelogram frame is applied at the end of a rocking lever to equalize the pull of the regulating electromagnet. In this lamp there is also introduced the principle of oblique approach; for the armature of the electromagnet is not allowed to travel straight toward the poles of the magnet, but is pulled up obliquely past it.

Another device for equalizing the pull was used by Wheatstone in the step-by-step telegraph in 1840. A hole is pierced in the armature, and the end of the core is

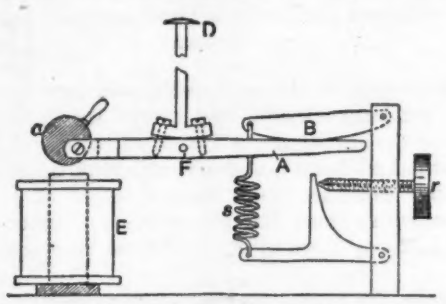


FIG. 71. MECHANISM OF DUBOSCQ'S ARC LAMP.

formed into a projecting cone, which passes through the aperture of the armature, thereby securing a more equable force and a longer range. The same device has reappeared in recent years in the form of electromagnet used in the Thomson-Houston arc lamp, and in the automatic regulator of the same firm.

(To be continued.)

On Standard Wire Resistances.

At the recent meeting of the American Institute of Electrical Engineers a most interesting report was received from the Standard Wiring Table Committee dealing with its researches into the experiments made to determine the resistance of copper. We give the report as it was received, although it has since been somewhat modified by action of the institute in taking the soft copper standard mentioned instead of the hard copper standard.

Preliminary Report of the Standard Wiring Table Committee in Regard to Matthiessen's Standard of Resistance of Copper.

The council of this institute at its regular monthly meeting, held Dec. 3, 1889, appointed a committee "to formulate and submit for approval a standard wiring table for lighting and power purposes." The committee appointed consists of the following members of the institute: Thomas P. Conant, Dr. Louis Duncan, Prof. Wm. E. Geyer, A. E. Kennelly, George B. Prescott, Jr., E. Wilbur Rice, Jr., Prof. E. P. Roberts, Prof. Harris J. Ryan, William Stanley, Jr., Dr. Schuyler S. Wheeler, and Francis B. Crocker, chairman. This action was taken by the council with the object of overcoming or reducing the great confusion which now exists in regard to the standards and constants of electric conductors.

At the first meeting of the committee held Jan. 10, 1890, it was decided to confine the work at first to the three subjects of standard of resistance, temperature coefficient and safe carrying capacity of copper, since these are of fundamental importance.

The subject of Matthiessen's standard alone is so confused and involved, and the discrepancies are so great between the best authorities that the committee has devoted its attention almost entirely to this subject up to the present time. After a very thorough investigation of Matthiessen's work with a view to ascertaining what his standard really was, by a sub-committee, consisting of Prof. Wm. E. Geyer, Mr. George B. Prescott, Jr., and the chairman, the conclusion has been reached that Matthiessen's "mile standard" (one statute mile of pure copper wire one-sixteenth inch in diameter has resistance of 13.59 B. A. units at 15.5 degrees C.) is not the true one although very commonly used. We consider the correct Matthiessen's standard, and the one in which he himself had most confidence, was the "metre-gramme" standard (resistance of pure hard-drawn copper wire, one metre long weighing one gramme = .1469 B. A. units at 0 degrees C.). This has the disadvantage that it is expressed in terms of weight instead of diameter. It is, however, very much more difficult to get the exact mean diameter of a wire than to get its exact weight, as Matthiessen himself states. Furthermore, by selecting the most reliable constants given by Matthiessen, and corroborated by investigation and correspondence with the best authorities, we have by calculation converted this "metre-gramme" standard into a standard referred to dimensions and independent of weight, which is the form generally used. The various constants selected, the method of calculation and the values deduced are given in a table at the end of this report.

As to the fact that wires may be found which test 102 per cent. of Matthiessen's standard, or even higher, we are of the opinion that this is no real objection, provided the value of the standard is definite and generally accepted. A standard which is not the highest attainable value may even be considered an advantage, since the average commercial wires will approximate to it more closely.

Although we believe the standard we recommend will answer the purpose temporarily, and probably permanently, nevertheless we think that if a thoroughly correct and complete redetermination of the standard resistance of copper could be accomplished it would be a benefit to electrical science and industry. Favorable offers in this direction have already been received by this committee from the Johns Hopkins University, Cornell University, and Columbia College, and it is very likely that this redetermination may be undertaken.

This committee purposes next to take up the subject of the safe carrying capacity of wires. Matthiessen's standard recommended by this committee is: A hard-drawn copper wire one metre long, weighing one gramme ("metre-gramme"), having a resistance of .1469 B. A. units at temperature of 0 degrees C.* From this standard we calculate by taking the value 8.89 for the specific gravity of copper, that a hard-drawn wire one metre long and one millimetre in diameter ("metre-millimetre") has a resistance of .02104 B. A. units at 0 degrees C. This value is also given by Matthiessen.† Matthiessen's figures‡ for relative conducting powers are: Silver, 100; hard or unannealed copper, 99.95; soft or annealed copper, 102.21.

From these the resistance of hard copper is found to be 1.0226 times that of soft copper; therefore, the resistance of a soft copper wire one metre long and one millimetre diameter is .02057 B. A. units at 0 degrees C. From this the resistance of one cubic centimetre of soft copper is found to be .000001616 B. A. units at 0 degrees C. And the resistance of soft copper wire one foot long and .001 inch in diameter (mil-foot) is 9.720 B. A. units at 0 degrees C. Taking one B. A. unit as .9889 legal ohm, any of the above values may be converted into legal ohms. To find the conductivity of copper at temperatures other than 0 degrees C., Matthiessen's formula may be used:

$$C_t = C_0 (1 - .00387\, t + .000009009\, t^2).$$

Table of Values Based upon Matthiessen's Correct Standard.

	B. A. units. 0° C.	Legal ohms. 0° C.
Matthiessen's standard metre-gramme, hard	.1469	.1453
Metre-gramme, soft	.1436	.1420
Metre-millimetre, hard	.02104	.02080
" " soft	.02057	.02034
Cubic centimetre, hard	.000001652	.000001634
" " soft	.0000001616	.000001598
Mil-foot, hard	9.940	9.829
" soft	9.720	9.612

Specific resistance of hard copper (1 cu. cent.) = 1634 (C. G. S. units)
" " soft " (1 ") = 1598 (" ")
Matthiessen's standard specific gravity of hard copper, 8.89.
Resistance of hard copper is 1.0226 times that of soft copper.
" soft " is .9779 times that of hard copper.
Legal ohm is equal to 1.0112 B. A. units.
B. A. unit is equal to .9889 legal ohms.

After reading the report Prof. Crocker, the chairman, added the following very interesting details concerning the practical side of the resistance question, and the information that he had been able to obtain as to the classical experiments on which our present standard is based. Prof. Crocker said:

"Of course the derived values follow as soon as the fundamental standard is decided on, and the question, therefore, is, not what the derivations are, but whether the fundamental standard is correct; in other words, whether Matthiessen's 'mile standard' or Matthiessen's 'metre-gramme' standard is the more reliable. Now, the sub-committee has investigated this particular point with a great deal of care, and arrived at a very definite conclusion—that the metre-gramme standard was unquestionably the more accurate and the more reliable of the two, and that Matthiessen himself so considered it. Fortunately, after having decided this, we received a letter from Mr. Latimer Clark, who is one of the best authorities on this matter and who was a contemporary of Dr. Matthiessen, in fact he suggested to Dr. Matthiessen that he undertake these experiments, so he is specially competent to express an opinion on this subject, and he agreed with our conclusions in every respect. We had already arrived at these conclusions, so his letter was simply corroborative. Mr. Latimer Clark's letter to the committee covered the subject very thoroughly and clearly, and I wish here to express our thanks to him for his kindness. There is, however, considerable confidence in the mile standard, and I think that it is simply that it has been used, and the fact that a mile and a sixteenth of an inch are more familiar values for the ordinary American and English engineer than a metre and a gramme, but the metre-gramme is just as capable of being transformed into practicable and common units as the mile and sixteenth of an inch. The necessity for deciding on some standard is more urgent than would be ordinarily supposed. This morning, for instance, in my ordinary professional work, I referred to two wiring tables issued by presumably competent persons and both intended to be correct and both being such as an engineer would use in his practice. One of these tables gave the resistance of No. 25 B. & S. gauge copper wire as 33.4 ohms per pound at 75 deg. Fahrenheit. The other gave it as 34.7 ohms per pound at the same temperature. Now there is a difference of 1.3 ohms in 33 ohms, which is about four per cent. In some cases it does not make very much difference whether it is four per cent. one way or the other, but four per cent. is a very considerable discrepancy, and in a great many cases it would make a very serious difference. For instance, I was figuring on 16 pounds of wire, and it made a difference of almost 21 ohms. That is not only measurable, but it is a serious matter in some cases. I think that when two wiring tables that electrical engineers ordinarily use differ by four per cent. it is time to do something. I just happened to pick up these tables this morning. I did not do so with reference to this subject. I dare say if I looked for discrepancies I could find much greater ones. The adoption of this standard does not mean that every wire used for commercial purposes

* *Philosophical Magazine*, May, 1865.
† *Philosophical Magazine*, May, 1865.
‡ *Philosophical Transactions*, 1864.

shall be 100 per cent. of Matthiessen's standard. There is no reason why an electrical engineer in his specifications should not require 101 per cent. if he considers it necessary, and I can think of cases where it might be necessary. On the other hand, it might be sufficient if the conductivity was 97 or 98 per cent. of the standard. It is simply necessary that we should have some definite value.

"The question whether any standard at all is necessary is a more important one; as it is not absolutely necessary to have a standard. We could simply say that one mil-foot or one cubic centimetre of the copper used for a certain purpose should have such and such resistance—in other words a certain specific resistance. But practical men have become accustomed to using Matthiessen's standard, and they seem to want a standard, and they will use one whether we want them to or not; such being the case I think it better to decide what Matthiessen's standard is. It certainly is commonly used. You see the expression in every book and almost every paper and specification, and as it now has no definite value—even though it is not used in the future, just simply to have it settled once and for all, I think it would be well to settle upon a definite standard. We feel sure that the institute will make no mistake in adopting this as Matthiessen's standard, and unless there is some particular objection to it which has not been brought out by our investigations, we hope the institute will do so."

Mr. Geo. B. Prescott, Jr. then added some further details of the committee's investigations and made the suggestion, which has since been followed, of taking the soft copper standard in preference to the hard. Mr. Prescott said: "In making this report the committee has not thought it necessary to go into detail very much, and it may be interesting to members of the institute to know how this discrepancy in what is called Matthiessen's standard has arisen. In the first place, it is perhaps worth while to inquire why this standard was adopted in preference to any other. The reason was because Dr. Matthiessen made a series of careful experiments to determine the resistance of metals and the variation of their resistance with changes in temperature, which extended over a great number of years and formed the basis of the work of the British Association, which decided on the practical standards. It seems that years before this British Association Committee undertook this labor various standards of resistance had been proposed by German, French and English electricians, and they were of all kinds, and among them was one proposed by Dr. Matthiessen, which was this 'standard mile.' There were no ohms in those days, and he made up a standard mile of this copper and that was used as a unit in England for a long time. Later on, when the committee of the British Association had determined the value of the ohm in absolute units and had prepared practical standards, part of this committee tested the different standards that had been made in different parts of the world, including this standard of Matthiessen, and when they measured it they found that it was equal to 13.59 British Association ohms. Matthiessen never gave it that value; it was simply an arbitrary standard that he selected, because it was a convenient unit. Probably it was the size of wire commonly used in those days, so that really it never was a standard except in that sense. After Matthiessen's work was completed and published, Dr. Fleeming Jenkin, who was the secretary of the association, tabulated the results. Matthiessen's measurements were made with respect to weight and length, and also diameter and length. But his measurements of diameter were always very unsatisfactory, and finally the only measurements that he really relied on were those of length and weight. But he made a very great mistake, which he himself acknowledges in his reports, which was that he neglected to take the specific gravity of the actual samples that he experimented on, and the result, of course, is easily understood. Every sample of copper varies somewhat in its physical properties, and if you were to take one hundred samples of wire and measure their resistances at a given weight and length, and then attempt to calculate the resistance from the cubical dimensions, you would find a difference, simply because there is a difference in the drawing of wires which changes their molecular constitution. Dr. Matthiessen neglected to take the specific gravity of any sample of wire that he tested, and the result is that we do not know to-day what Matthiessen's standard is, except in terms of weight and length.

"A further complication arose in this way, that Dr. Fleeming Jenkin, who as I say, tabulated the results which Dr. Matthiessen obtained, made all sorts of derivations, giving the resistances in foot-grains and foot-mils and metre-grammes and metre-millimetres—all by calculation. Of course in converting from length and weight into length and diameter he had to use specific gravity. He selected certain specific gravities. In his original table there are errors. Those errors have been copied. Other people have calculated tables from the standard mil unit, and of course they give different results, so when Matthiessen's standard is referred to to-day, there is a great deal of uncertainty as to which standard is meant. As a matter of fact, the statute mile standard is probably nearer the true resistance than the meter-gramme, for the reason that it gives a higher conductivity, and there have been any number of cases of wire being tested that had greater than 100 per cent. conductivity, and it was for this reason that seven or eight years ago I calculated a wire table, and selected this unit of Matthiessen's simply because it was the lowest, and agreed with some results that I had actually obtained."

Mr. George C. Grower said: "I think there is a mistake made when hard copper wire is assumed as the standard and the resistance of soft copper reckoned from it. This takes for granted that there is a fixed ratio in resistance between hard and soft copper. But this ratio depends entirely upon the hardness of the hard copper compared with the soft. For instance, if you take large copper wire and have it as hard as you can get it, the conductivity would be almost as good as soft copper, while in a small wire it would not be nearly so good. I have had as much as eight per cent. difference between hard and soft copper made out of exactly the same stock on small wires. If we should make the wire very small, I dare say it would make still more difference.

"I agree with the committee that the metre-gramme standard is the more reliable, because whenever I have tried to make tests with diameter I could not get any sort of agreement among them; but where I take soft copper standard, no matter what the size of the copper is or anything else, so long as it is soft copper and from the same stock, I get almost the same result. But if you take hard copper for the tests, the tests will differ several per cent. according to the size of the copper. I think, for that reason, the standard should be soft copper of a given length and weight."

Mr. Crocker said: "It is perfectly correct as an abstract statement that soft copper is more constant in its resistance than hard copper. Hard copper can be made of almost any resistance up to several per cent. above soft copper. But soft copper is not Matthiessen's standard; it is precisely like the case of the foot. The English foot originally, I have heard, was the length of the King's foot. Well now, at the present day, I think it is a little in excess of the average length of the human foot. But it does not make a particle of difference, providing it has a definite value, as it has, and providing a correct copy of the standard is kept in a safe place—it does not make any difference whether it is an inch longer or an inch shorter than the human foot. It has a definite value, and no one, I think, at the present time, would recommend changing the English foot, as a unit of measurement, to agree more closely with the length of the anatomical English foot. It is precisely the same with Matthiessen's standard. Unfortunately or fortunately, as you may look upon it, Matthiessen has promulgated a standard, and it has been largely, in fact almost universally accepted. Now all that is necessary is to adopt a definite value for this standard. It does not make much difference what it is, provided it is definite and generally accepted. Of course, in selecting a definite value we want to select the best one, the most reliable one, the one that he himself considered most reliable, and the one that other authorities deem the best. So it seems to me that the mere fact that one standard or another approximates more closely to what the highest possible value is, or the fact that one or the other happens to be easier to determine in practice, makes no great difference, provided we get a certain definite standard or resistance for various lengths, weights, diameters and kinds of copper. I think that all that is necessary is to free this subject from its great confusion by simply adopting a definite standard, and if that standard happens to be more correct than some other, so much the better; but even if it is not, it is very much better than confusion."

It is to be hoped that this report of the Standard Wiring Table Committee will receive the attention it deserves as it certainly has gone far to straighten out the complex tangle into which some careless copying of constants has led. The report is both a judicious one and worthy of receiving general adoption.

Discussion of Prof. Nichols' Paper on "The Artificial Light of the Future."*

The lecture was most enthusiastically received, and after a formal address of thanks by the president of the club the discussion was opened by Dr. Otto O. Moses, who called special attention to the relations borne by phosphorescence and fluorescence to the problem in hand of obtaining efficient light. He was of the opinion that the phenomena were invariably accompanied by storing of energy, so that perhaps luminescence must necessarily be accompanied by a previous storing of energy.

Mr. Wetzler then spoke of the possibility of producing illumination by means equivalent to using the spark from an induction coil, in other words, by the direct raising of gas to incandescence by a violent discharge.

Prof. Nichols in replying said: "I do not know of any efficiency measurements excepting those which I have tried to give you some account of to-night. It is a subject which has not been worked up so far as I know, except this case of the spark discharged in vacuo and in rarefied gases by Prof. Staub and in Mr. Langley's work upon the fire-fly, and in the well-known work that has been done recently by various observers concerning gas and oil and candles and the electric light."

Mr. Tesla then took up the subject and said: "Mr. Wetzler has mentioned the spark. We know that an enormous amount of energy can be transferred through the spark, so it cannot be very efficient; but it is not this point I wanted to mention. Prof. Nichols has mentioned several things to-night which are somewhat in the line of work I followed some time ago. I did not at that time understand quite as fully as I understand to-night the various points, but I might mention certain work which I did several years ago. Of course we know the beauty of the magnesium light, and it occurred to me several years ago that it might be practical to utilize it. But we must, if we utilize the magnesium light, utilize the magnesium in such a manner that it is spread over a great surface something like in the Geissler tube—the molecules of the gas. After various trials I hit upon a plan. I do not know whether it has been followed anywhere. I produced arc light carbons and incandescent carbons. I took chloride of magnesia. As we know, the chloride of magnesia dissolves in water, and this chloride of magnesia I mixed with carbon powder. I took arc light carbon and powdered it well, and so I made a paste. Now in this manner you see I distributed that magnesia perfectly over the whole mass of the carbon. Now you know that when the carbon is heated the magnesia is decomposed, and the chloride goes away, so that when the carbons were baked and were burned in the arc they gave this magnesia effect. I have also in this manner produced incandescent carbon filaments, and my method of fixing this magnesia on the incandescent carbon was this: I first took a fine carbon, a thin string, which I carbonized. This I made incandescent in a hydrocarbon, to strengthen it. Then I had a solution of the chloride of magnesia, or I tried in some other instances zinc oxide. I would put this carbon into this chloride of magnesia solution and flash it up. Now the heat of the carbon will decompose the solution and the magnesia will deposit on the carbon. Now, then, I have to fix that on the carbon. If I would heat it, it would soon go away from the carbon. Then I would dip it again into the hydrocarbon and flash it in the hydrocarbon. I would now deposit on the top of the layer of magnesia another layer of carbon. In this manner I produced lamps which gave a remarkably nice white light. But as I was always anxious to test them with a high candle power, I cannot tell anything about light, but I can tell this, that about three or four years ago I got the first Austrian cored carbons in hand. You remember that those carbons give about the best light. I found in this Austrian cored carbons that they gave just exactly the same effects as those which I had made, and I presume that they must use some such progress as this. Now perhaps some of the gentlemen associated with the manufacture of carbon know some more points. But I think that in this line of work a great deal can be improved and that in this manner the point brought out by Prof. Nichols may be utilized.

"Prof. Nichols also mentioned, I believe, that the flames, when they are subject to a good draught, diminish in luminosity, and if I understood right, it was an argument to show that it is not the temperature in the arc which is in any way connected with the intensity of light. I think it is pretty safe to say that in all cases where we can keep away chemical association or a disintegration, that if we can raise the temperature, as we raise the temperature the body gains steadily in luminosity and it is only due to a chemical process when we send a draught through the flame that the luminosity is diminished. But we can see in the flame, for instance, which is obtained by passing a jet of air through the flame that the intensity of the light may be sensibly increased by passing a draught. Now if the carbon can be prevented from breaking, then we may avail ourselves of the advantages we gain at the higher degrees of incandescence. This is a point on which I am not now able to speak, but I have some notes in that direction. It is a different plan of work and at some time or other I may be able to bring it before you."

Dr. Moses, speaking in something along the same line of possible methods of getting electrical luminescence, then made the following interesting remarks on some early attempts in this direction: "In order to keep this ball moving, and it is exceedingly interesting, it would be well to call attention to the fact that as far back as 15 years ago experiments were made to combine the use of metallic oxides with the flames both from illuminating gas and from the arc light carbons. There are two very notable instances where the volatilization of metallic oxides has tempered the light and tended to give it different shades of color, which we use in the arts, notably the lamp soleil, where the arc volatilizes calcium oxide. That was a crude experiment. It seems to have died out from mechanical inability; that is, it was impossible to supply the material sufficient for the purpose of producing the light regularly unless a cylinder of magnesia was used. The magnesia itself had been prepared in a secret way. It was almost as hard as corundum. The arc light was allowed to play upon that. It was kept incandescent. The carbon points were not very incandescent. The current seemed to pass through the arc itself and through the good conducting semi-fluid magnesia. It made a very beautiful light, the most beautiful that I have ever seen under any circumstances. It is a wonder that those experiments have never been conducted by ingenious Americans. It was a Frenchman who invented this.

"There is a point that is struck out by Mr. Tesla, though that I think ought to be put into Prof. Nichols' valise to carry home with him. He has given us so much that we ought to give him as much as possible in return. He makes a remark there which is very valuable when he speaks of the condensation of an atmosphere like oxygen around an incandescent body being able to produce a greater intensity of light. I think he misapprehended Prof. Nichols, however; but that is a matter for subsequent personal explanation. But a very curious analogue presents itself when you consider the passing of a current through a conductor whose vibratory action is to give you luminosity. It is a known fact that by diminishing the amount of gas around it you increase the luminosity in a very remarkable degree. I believe Prof. Nichols assisted in those experiments some twelve or fourteen years back, in which, as you will observe, the current passing through the conductor meets with some resistance, and the vibratory action set up in the conductor was to give light, you remove the superincumbent atmosphere, and you find the light rising with a very remarkable rapidity. Now that seems to be an inverse action. It would be well to consider this point. If we have oxygen compressed giving a greater luminosity when you have incandescent particles in it ignited, if you then reverse the process, and, instead of sending air, send a fluid through the conductor and remove the pressure on the outside, you get increased light. It operates by a kind of analogy—the effect of the progress of the fluid within the conductor when the current is passing. It does look heretical for one to begin to assume that electricity is a fluid, but I am getting more and more back to the old views on that thing, that we are dealing as much with a fluid as the atmosphere that surrounds us at this moment. However, keep the ball in motion."

Mr. Tesla then took up the discussion in his characteristically pointed way, and upon taking up some of the points suggested during the early part of the discussion by Dr. Moses, said: "Dr. Moses mentioned the lamp soleil. A piece of marble was put between the two carbons and the gain consisted in bringing up by a gradual heating of that marble, storing a great amount of heat into the body which does not radiate very much considering its bulk, so that this light became steady, and the lamp, I believe, gave a very steady and beautiful light. That was the object of using the marble and it has nothing to do with the point that I have brought out, the use of magnesium in the carbon. As regards the point that the greater light is obtained by passing a fluid through the conductor this is due to the fact that by passing that fluid through the conductor we afford a channel for taking away heat.

"There is another point that Dr. Moses mentioned. It struck me as very queer, if I may be permitted to say so, and that is as to the rotating disc cutting through iron. He thought there was very little heat generated. Well, I made a few experiments in that direction. I found 25,000 or 40,000 feet a minute, and when you come to consider the enormous speed of the disc and the amount of heat you get in these sparks flying away, you will soon realize that there must be some heat generated. I do not believe in the theory Dr. Moses suggested, that there is little heat developed there. I believe there is all the heat developed that can be developed by friction."

After some brief further discussion Mr. Price moved a vote of thanks to Mr. Nichols for his very able and interesting lecture, which was enthusiastically carried, and the meeting then adjourned.

*See THE ELECTRICAL WORLD, Nov. 29, 1890.

An Anxious Customer.

The Consolidated Electric Storage Company has received the following letter from one of its customers, which indicates in a striking way what must be met in placing the Julien battery upon the market:

DEAR SIRS: The Hydrometer came O. K. in your directions E. M. F. of charging current should be equal to 2.3 volts. What is E. M. F. or is it 2 thirds of a volt or 2. or 3 volts.

We have an Incandescent Street Circuit direct from Denano 94 volts 16 Candle Power. They can put in cut

out box that will reduce thecurent to 14 Candle Power. We gave it a tryal connecting the wires to Positive and Negative poles of Battery and the other end to street current. We did not disconnect the wires runing from Battery to Moter. The instant we turned on the curent it Burnd the fuse in the cut out box. We saw that would not do so after putting a new fuse we connected the street wires to Dinamo when Battery wires were disconnected and it Burned the Brushes of Dennano. What size wire to use from Battery to Denamo, is the swich conected to Battery wires before the wires go to Denamo will I stick the Charging wires in the Liqwid or fasten them to Positive and Negative poles of termenals of Battery.

Must the wires runing to Battery be disconnected when charging the Battery.

I made the solution acording to directions I put the Hydrocter in the solution and it went to the Botton of the jars dose it indicate 20 Baume at the time the solution is mixed or after it is fully charged from Street Current let me know how to arrange it so it can be charged from the Current Mentioned.

You say to go over the Battery with a Battery gauge before starting to charge to see if they are all the same standard I have no Battery gauge therefore Cant say whether they are all alike I would like to know if in the 4 cells that I have and properly connected if it requires more than 2 wires a positive & negative to convay the curent to *Denamo* I would like to have pecific instructions In regard to what I ask as we have no Electrecion here that I can get any information from.

The Electric Light Co use a number of Different Batteries and are anxious to se the workings of this So do what you can for me as I am determined to give it a fair tryal and what ever your charge is send Bill.

Yours Kindly

* * *

The Electrical Stock Market

The buyers of small lots of stock have been numerous during the past week and stocks in both the electrical and general market have been so attractive on account of price that people who very rarely indulge in speculation have been desirous of investing. Saturday prices generally fell off a little, but not sufficient to mar the satisfactory result obtained for the week.

The president of a prominent savings bank in New York City is said to have made the statement that within a week he lost 350 depositors who closed their accounts in order that they might make investments in small lots of stock by buying them outright. These stocks will be stowed away in strong boxes and not see the light of day until the market for them has increased many points. People in these days, especially those in the large cities who have opportunities to keep posted on the ebb and flow of the financial current, are not satisfied with a six per cent. investment, and when an opportunity occurs for the purchase of a good standard stock at a reasonable price there are many who take advantage of it and buy outright for investment. These persons are not to be classed with those who rush in with every dollar they can obtain, placing it upon a very small margin and in case of a temporary reaction lose all.

The general market has been in a fairly satisfactory condition the past week. Stocks opened well on Monday, fell slightly during the early part of the week and generally recovered. The failure of several prominent houses in Philadelphia has not impeded the market to any marked extent, and all that is necessary now is an increase of money in circulation to produce most favorable results.

There is still a chance that the Bank of England will increase its discount over the present rate and people generally are frightened at the prospect. Even if such action should take place it is hardly likely to be very serious with stocks, and especially electrical stocks, at the present time.

The first of the year will soon be upon us, and the large amount of money which is afloat at that time—money received from dividends, transactions closing with the end of the year, money from the government, State institutions, interest payments, etc.—will be seeking investment, and this cause alone is sufficient to make the market tend upward at that time. The cables state that articles of association for a company acquiring the business of Baring Bros. & Co. were recently registered at Somerset House. A number of credit firms in Buenos Ayres are reported to have failed and gold is said to have reached an enormous premium in that city.

England, it seems, is not likely to meddle with our stocks to any alarming extent for some time to come, for with some $700,000,000 to $800,000,000 of Argentine securities to nurse, on which little money can be procured, she can be safely calculated to look after affairs at home. It may also be worth mentioning to state that the market abroad at the present time is in very poor condition to attempt to float companies representing American business, manufactories, etc.

The tendency to clear the financial atmosphere, and to bring securities to a basis where they represent what they should, the value of the property behind them, has been the substantial benefit derived from the past financial crisis. Right here it is perhaps well to caution persons forming electrical corporations against the evils of overcapitalization.

Stock should represent property at least near in valuation to the amount it indicates. The public is fast coming to look with suspicion on companies of vast capitalization unless like interests are represented by them, and it will tend to the advantage of the inventor generally, even though conviction may be great that his invention will revolutionize trade, to have companies formed on a cash value basis. When he has succeeded in revolutionizing trade he can very readily form another company on a larger basis, absorbing the original one, and issue the new stock on the increased value of his property. In this way the public is more likely to believe in him, and to demonstrate it by rapidly purchasing his stock.

In many cases local electric light companies have been overcapitalized to the great detriment of all concerned, with the possible exception of the promoter, who has made a small outlay of time and money, and has issued to himself one-third of the stock of the corporation for compensation. Investors nowadays ask many questions, and it is not possible for the promoter to keep the fact from the public that he has issued stock to himself without paying for it, and expects the public to come in and buy at perhaps 50 per cent. of par value. Such transactions are likely to cause distrust and failure.

Western Union stock has remained very steady this week, and closes, as is shown by the report, at 78. It is likely by the first of February this stock will reach 85. The rumor is that Mr. Gould's policy is to put several of the properties which he absolutely controls on a much higher plane, and prominent among these properties is Western Union.

The statement issued last week by the American Bell Telephone Company of the output of telephones for the month is very satisfactory. The statement shows a net increase of 1,558 instruments over the same period in 1889. This stock reached 217 on Monday and reacted slightly during the week, closing at 215.

The statement issued by the Thomson-Houston Electric Company for the first nine months of the fiscal year is most satisfactory, from an investor's point of view. The earnings are represented as $7,514,520, or an increase of $2,266,895 over last year, the net profit for the same period amounting to $1,631,715, which is $656,452 over last year. Two million four hundred thousand dollars in securities were divided among stockholders last year which cost the company about one million and a quarter. This statement gives evidence of the remarkable success of the company, and makes its stocks among the most widely sought after of all electrical securities.

Edison Electric Light stock has remained very steady this week, but closed at 85, a point and a half below last week's report. It has simply followed the course of the railroad stocks on the New York Exchange, as it is listed there, the slight drop taking place the last of the week. Mr. Henry Villard, president of the Edison Company, returned to this country on Saturday, but refused to be interviewed concerning any of the securities in which he is interested. It is probable when he has had time to look over the situation he will give out a statement which will be of interest to all concerned. The Edison Company has right to be proud of the action of their stock under the attacks of the recent panic.

Westinghouse stock has fallen about four points since last report. Transactions in it are very numerous at Pittsburgh, and it looks as though strong parties at that point are attempting to bear the stock for the purpose of buying it up later.

The closing prices on Saturday, Nov. 29 (Pittsburgh closing Nov. 28), as furnished by F. Z. Maguire & Co., 18 Wall Street, New York, were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
NEW YORK.				
Western Union Telegraph Co.	100	86,200,000	78	78⅜
American Telegraph & Cable	100	14,000,000	83	85
Central and South American	100	5,000,000	1.55	1.65
Mexican	100	2,000,000	2.10	2.15
Commercial Cable Co	100	7,716,000	1.01	....
Postal Telegraph Cable	100	5,000,000	39	41
Edison General Electric Co.	100	9,503,500	85	88
" " " Deferred	100	2,496,500	....	....
Consolidated Electric Light	100	1,922,400	....	....
Edison Electric Illuminating Co.	100	2,567,800	....	....
United States Electric Light	100	1,500,000	30	....
North American Phonograph	100	6,200,000	30	35
BOSTON.				
Thomson-Houston Electric Co.	25	6,000,000	42⅝	42⅞
" " preferred	25	4,000,000	25¾	26
" " Series C	10	400,000	....	12¼
" " Series D	10	120,000	5⅝	....
" International Co.	100	350,000	....	....
Thomson Welding Co.	100	1,000,000	....	2.00
" European Welding Co.	100	1,500,000	....	60
Ft. Wayne Electric Co.	25	4,000,000	11	11½
Telephone:				
American Bell	100	12,500,000	215	216
Erie	100	4,800,000	47	48
New England	100	10,304,600	....	50
Mexican	10	1,280,000	75c.	85c.
Tropical American	10	400,000	....	1¼
MISCELLANEOUS.				
Edison Phonograph Doll	10	1,000,000	1¼	2
WASHINGTON.				
Pennsylvania Telephone	50	750,000	25	....
Chesapeake & Potomac	100	2,650,000	....	73
American Graphophone	10	600,000	12	12½
United States Electric Light (Washington)	100	300,000	140½	145
Eckington and Soldiers' Home Electric Ry.	50	352,000	59¾	60
Georgetown and Tennallytown	50	200,000	48¼	55
PITTSBURGH.				
Westinghouse Electric Mfg. Co.	50	5,000,000	20⅝	....

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	57@ 58	Wisconsin	118@ 120
Michigan	91@ 93	Bell of Missouri	155@ 160
Great Southern	32@ 35	Iowa Union	20@ 21
Colorado	38@ 40	Missouri and Kansas	55@ 57
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.			
Chicago Arc Light and Power	$85@$90	Chicago Edison Co.	$128@$130

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Dec. 1, 1890.

A New Electrical Society.—The Franklin Electric Society has been organized in this city, with headquarters at 241 East Fifty-ninth street.

Schieren's Belts.—Chas. A. Schieren & Co. have just furnished the Louisville Cotton Mills, Louisville, Ky., 80 feet of 32-inch very heavy three-ply perforated electric belt.

The American Society of Mechanical Engineers gave a very enjoyable reception to the members and their friends on Friday evening of last week, the occasion being a house warming at the new home of the Society, 12 West Thirty-first street, this city, which is now occupied conjointly by the Mechanical Engineers and the American Institute of Electrical Engineers.

The Crosby Electric Company has received the highest award at the American Institute Fair, for its dry battery, the Hussey blue stone battery and the Eclipse battery. This company has purchased all the business and patents of the Federal Electric Company of 10 Cedar street, this city, including Hayden's electric cigar lighter, which will hereafter be known as the Crosby cigar lighter.

Electrical Club Dinner.—As we go to press a notice comes of a very pleasant dinner at the Electrical Club on Thursday evening, Dec. 4. It is intended to have these social occasions alternating with the regular monthly lectures of the Club, and from what has already been accomplished in the line of these gatherings of the electrical fraternity it can be confidently said that the members of the Club will find this social addition to its regular meetings most acceptable.

Mr. A. B. Laurence, of the New York office of the Shultz Belting Company, reports among his recent sales that of eight link belts for the Lindell Electric Street Railway of St. Louis, each 24 inches wide by 80 feet long; one link belt for the Pratt Institute, Brooklyn; one for the National Meter Company, 252 Broadway, this city; one for the Squires Manufacturing Company, of Buffalo, N. Y.; six 12-inch link belts for the American Express Company, Hudson street, this city; four 10-inch link belts for the Lakewood Hotel, Lakewood, N. J.; two 10-inch link belts for the Deutsche Verein Club, this city; four 12-inch link belts for the new Music Hall, this city; and one 12-inch for the Excelsior Jute Mills.

South Lakewood Park, the Electric City.—This pretty winter resort, through its successes, has been raised to the highest place among the brilliant enterprises of its founder. Among those who have purchased property in this attractive spot may be mentioned the following: Rev. Dr. Geo. Johnson, W.W. Bentley, Rev. Dr. Howard, Miss Mary Norcross, Miss L. M. Elliott, Mr. Louis Delsart, Mr. Jos. Osborn, Miss Davenport, Frederick S. Roberts, all of Lakewood, N. J. Besides these may be mentioned, of the electrical people, C. E. Stump and W. T. Hunt, of The Electrical World; H. L. Shippy, of the Roeblings, the *Electric Age*, *Electric Power*, F. Z. Maguire, P. H. Alexander and scores of others. An elegant station is about to be built, and the electric tower which will illuminate this future Elberon of Lakewood will be built by Messrs. Alexander, Barney & Chapin. This tower will be 150 feet high, and will be lighted by arc lamps of 20,000 c. p., and it is intended, as the city increases in size, to increase the lights on the tower.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, Nov. 29, 1890.

The Mather Electric Company, of Manchester, Conn., is adding a 75 h. p. Harrison boiler to its power department.

The latest novelty is a rubber-handled screw driver now being introduced by the Standard Electric Supply Company of Boston.

The Eddy Electric Company, of Windsor, Conn., will triple its present facilities in the spring. Plans have already been drawn and approved for a new addition, 154 × 50, a new office building separate from the factory and various other extensions. This company has plenty of work on hand, the merit of its productions having been quickly recognized by the trade. A New York office at 15 Cortlandt street was recently opened, with W. C. McIntire in charge.

The C. & C. Motor Company has installed a 40,000-watt machine in Waltham, Mass., for running the new power circuit. This company has already installed 10 h. p. of motors, and new applications are being received daily. The probabilities are that within a short period the whole power will have been taken. The C. & C. Company has just installed a 10 h. p. motor in connection with the elevator at the Bowker Street station of the Edison Illuminating Company, Boston.

Berrenberg Pump and C. & C. Motor.—Every visitor at the Fair is at once struck with the height and volume of the fountain that rises from the centre of the exhibition hall, and is pleased with the sparkle of the spray produced by the brilliancy of the electric light rays. Few visitors imagine that this wonderful work is effected by a little rotary pump that can be taken under the arm and easily carried away, but this is true. The pump that does the work is the invention of Adolph Berrenberg, the originator of the Beacon vacuum pump. The pump is driven by a C. & C. electric motor.

Laconia, N. H.—The Laconia Electric Lighting Company has secured the contract for 10 additional arc lights of the Arnoux-Hochhausen system for Lake Village, one and a half miles from Laconia. The construction work has been awarded to Robert G. Reilly, besides the construction of another line to Lake Village for alternating current commercial lighting. Mr. Reilly has also installed a 30-light incandescent dynamo for the White Mountain Hosiery Mills at Laconia, and has just received an order for a 25-light incandescent dynamo for the American Twist Drill Company, Laconia.

The Shipman Engine.—It was the good fortune of your correspondent to see the Shipman Engine in use during the last week doing its work well. A two h. p. engine using oil running at a cost of seven cents per hour and furnishing power for a 20 light incandescent machine is now on exhibition at the show rooms of this company. Mr. A. P. Cowley, of St. Paul, is now using a two h. p. engine of this make to run two eight light machines, one for two lights, a printing press, grindstone, emery wheel, and a No. 6 Barnes engine lathe. The engine runs at 375 revolutions per minute very freely with 60 pounds of steam, and without noise.

L. H. H.

PHILADELPHIA NOTES.

Branch Office of the Electrical World,
31 City Building, Philadelphia, Nov. 29, 1890.

Messrs. Chadbourne, Hazelton & Co. are installing one of their electrically actuated elevators and a Wenstrom motor for the Central Savings Bank of Canton, O.

A New Company.—A charter has been issued to the Spring Garden Electric Company, of Philadelphia, with a capital of $10,000. Directors, Aaron Fries, Joseph J. Martin, Dr. L. S. Filbert, Ed. J. Houston, James McManes, R. N. Carson, Ernest H. Davis, of Philadelphia.

Mr. Harry G. Clay, Jr., of 1,218 Filbert street, this city, has assumed management for Philadelphia and vicinity of the Thomson-Houston electric railway system, and has established a branch office at 230 North Charles street, Baltimore, with Mr. Davies Murdoch, late general agent of the Baxter Motor Company, as manager of that branch.

Messrs. Walker & Kepler have just finished installing the following Edison incandescent electric light plants in Philadelphia: Wm. Sellers & Co., iron works, Sixteenth and Hamilton streets, one 170-light dynamo; Samuel Bowen & Sons, North Penn Junction, one 90-light dynamo; Keystone Watch Case Company, Nineteenth and Brown streets, one 600-light dynamo; Thos. Henry & Sons, cotton mills, Trenton avenue and Tioga (increase), one 170-light dynamo; Philadelphia Knitting Mills, Sixteenth and Indiana avenue, one 90-light dynamo.

Messrs. M. R. Muckle, Jr., & Co. have placed with Messrs. Walker & Kepler, the local Edison agents, an order for three 500-light dynamos of the Edison compound wound multipolar marine type. These dynamos are to be used in the new buildings of the Drexel Institute at Thirty-second and Market streets. The machines are to be built on the general lines of those built for the United States navy, the only variation being in the voltage, which will be 100 instead of 80. The full complement of voltmeters, ammeters, etc., will accompany the machines.

Messrs. Wright & Starr have just taken charge of the storage plant of Mr. James H. Wright, at his country place in

Germantown. The plant consists of a 25 h. p. vertical tubular boiler an 8 h. p. New York Safety engine, a No. 4 100-light Edison dynamo, and a set of 110 cells of battery of the "Accumulator" type. The entire plant was installed by Mr. Walter C. Wright, and until about six months ago gave excellent service, having been in use for a period of about three years. Some of the cells a short time ago had deteriorated so much that the agents of the battery company deemed it advisable to change the system from a multiple series to a single series of 55 cells, and the battery has since done very good work. Messrs. Wright & Starr have decided to renovate the entire battery plant, so as to throw the present unused cells into operation. Mr. Starr, who has had about as large an experience with storage batteries as any one in this country, is thoroughly competent to undertake this work, and will be ably assisted by Mr. Wright, who has also had a large experience in the same line. The method of working will be to practically remake the deteriorated cells by reforming them. W. F. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Nov. 29, 1890.

Mr. Grant Beebe, manager of the Omaha office of the Pond Engineering Company, was a welcome visitor in Chicago last week.

Mr. Will H. Harbeck, of Toledo, O., is in Chicago arranging to place his silent electrical detective system in practical operation.

Mr. Thomas Palmer Whittier, of Saginaw, Mich., is visiting friends in Chicago and exhibiting his new open circuit battery, combining many of the advantages to be found in both the dry battery and the Leclanché cell.

Mr. C. A. Ross, manager of the Kansas City office of the Thomson-Houston Electric Company, has just closed contracts with parties in Richmond, Mo., for a 650-light alternating current incandescent plant and with parties in Seneca, Kan., for a 500-light alternating incandescent plant. Recently Mr. Ross also closed a contract at Kirksville, Mo., for a 650 alternating incandescent plant and for a 500-light alternating incandescent plant and a 30-light arc plant at Beloit, Kan., as well as one with the Vivian Stribling Company, of Norborne, Mo., for a 30 arc light machine.

Mr. F. G. Daniell has severed his connection as electrician of the Minneapolis Street Railway Company, to accept a more advantageous one with the Short Electric Railway Company, of Cleveland, O. Referring to the operation of the road, Mr. Daniell spoke in high terms of the efficiency of the apparatus furnished and of the excellent showing made by the underground conduit during several severe tests. This latter is a matter of congratulation to every one interested in railroad work, as it simply paves the way for the introduction of electric railways in many streets not now occupied and where overhead feeder wires and span wires would not be tolerated.

The Electrical Supply Company, of Chicago, has instituted suit against the Great Western Electric Supply Company of the same city to establish its claims to its trade name. The suit has been commenced in the United States Court and will be pushed to an issue, as it is desired by the Electrical Supply Company to thoroughly establish its right to the use of all or a part of the firm name. This company claims to have been the first in the United States to adopt the name "Electrical Supply," and since its first use it has become quite common as a firm title, which often leads to confusion, and is claimed to be detrimental to the interests of the Electrical Supply Company. The name "Electrical Supply" has been maintained by this company from the first, and it expects to establish a precedent restraining other companies from using these words, as the whole or a part, of a trade name. Further suits, it is said, will soon be commenced.

CINCINNATI, Nov. 28, 1890.

The Ball Electric Light Company, applied to the Board of City Affairs on the 14th inst. for permission to lay conduits in the streets and alleys of Cincinnati for the purpose of conducting its wires therein. On the 13th the Brush Company asked for similar permission. The board will take up the whole matter for discussion, but will probably make no grants till the Attorney General of the State has passed upon the matter. Just now there is but one conduit laid in the streets of Cincinnati, viz., on Pearl street between Broadway and Eggleston avenue, a distance of three or four squares. The conduit was laid by the Edison General Electric Company, which obtained its franchise from the Probate Court. It thus has a monopoly, but the grant permits the Board to supervise the construction and to approve or reject the application for particular streets. This is for the reason that Cincinnati has, within the last three years, expended $4,000,000 in paving the principal streets with granite, and the city objects now to tearing up these streets except except for good cause.

MINNEAPOLIS, Minn., Nov. 28, 1890.

Twin City Street Railway Construction.—The process of transforming the street railways of Minneapolis and St. Paul into electric lines, the initial labor of which commenced last spring, is about half completed at this date. What may be considered the most important lines in each city are now in regular and successful operation, and work continues uninterruptedly on the others. When Thomas Lowry, president of the Minneapolis Street Railway Company and the St. Paul City Railway Company, signed contracts with each city for the completion of this work on or before Nov. 1, 1890, a bond of $200,000 was exacted to insure the fulfillment of the obligation. The full extent of the work on hand was little realized either by the municipal government or by the public at large. It was undertaken with rare energy by the street railway companies, and but for unavoidable delays in securing the power engines from the Allis Company at Milwaukee and the motors from the factory the work would probably have been practically finished at the time specified. The failure has been satisfactorily passed upon by the St. Paul council, and the time formally extended until March 1, 1891. The Minneapolis council has not yet acted on the matter, but will unquestionably make a similar extension. In Minneapolis the following lines have been completed and are now in operation: Washington avenue, Riverside avenue, Minnehaha avenue, Twentieth avenue, First avenue to 34th street, Hennepin and Lyndale avenues, Fourth avenue to 34th street, and Hennepin avenue, Sixth street and Eighth avenue. The Western avenue and Cedar avenue lines will be completed within a few days. None of the east side lines have been finished, as connection with the west side will be impossible until the steel arch bridge over the Mississippi is completed. In St. Paul the following lines have been completed: Maria avenue, Mississippi street, Como avenue, Lexington avenue, University avenue; on Broadway, from Fifth to Grove; Tenth, from Broadway to Locust; Eighth, from Wabasha to Robert; Robert, from Seventh to Eighth; Concord, from Bancroft to Arthur; State, from Concord to South Robert; Smith avenue, from Ohio to Winnifred; and Smith avenue to Annapolis. On the University avenue interurban line the track is all laid and the wires strung, but the company will not have power enough to undertake its operation before December 15. Forty motors, with a capacity of 25 miles an hour drawing two "trailers," will be run on this line, giving an unequaled system of rapid transit between the two cities. Two other lines connecting the twin cities are contemplated, and Mr. Lowry believes their construction will solve the problem of uniting the cities. There are many citizens who agree with him in that belief. F. DE L.

SOUTHERN NOTES.

NORFOLK, Va., Nov. 26.

Roanoke, Va.—The telephone exchange has now 150 subscribers.

Danville, Ky.—A company is being organized to establish an electric light plant.

Roanoke, Va.—A power house is being erected by the Roanoke Electric Railway Company.

Macon, Ga.—The interesting question, can a voter register by telephone? has recently come up for discussion.

Marietta, Ga.—Additional machinery is to be added to the plant of the Marietta Electric Light Company.

Bowling Green, Ky.—The city council has decided to put in new machinery in the city's electric light plant.

Orange, Tex.—An electric light plant is being erected by the Orange Ice, Light and Water-Works Company.

Roanoke, Va.—An electric light plant will be established by the Crozer Iron Works Company for their private use.

Bedford City, Va.—New machinery has been added to the plant of the Bedford City Electric Light Company.

Frostburg, Md.—A new building is being erected for the electric light plant of the Frostburg Gas Light Company.

Lakeland, Fla.—The city council has granted a franchise for the erection and operation of an electric light plant.

Salisbury, N. C.—Parties are talking of establishing an electric light plant. The mayor can give information.

Batesville, Ark.—Parties have secured franchise from the city council for the erection of an electric light plant.

Tampa, Fla.—Additional machinery is being added to the electric light plant of the Florida Electric Company.

Brinkley, Ga.—The Cumberland Island Company is preparing to erect an electric light plant on Cumberland Island.

Sumter, S. C.—Additional machinery has been added to the electric light plant of the Sumter Electric Company.

Little Rock, Ark.—Improvements are being made to the power plant of the Little Rock Electric Light Company.

Savannah, Ga.—New machinery is being added to the electric light plant of the Brush Electric Light and Power Company.

Darlington, S. C.—The Darlington Electric Light and Power Company has been organized with a capital stock of $25,000.

Reidsville, N. C.—The city council has purchased the electric light plant which was formerly owned by a Danville, Va., company.

Henderson, Ky.—Parties are organizing the Henderson Electric Light and Power Company, with a capital stock of $50,000.

Helena, Ark.—An isolated incandescent system is being installed in the cotton-seed oil plant of the Anchor Oil Company.

Hinton, W. Va.—The city council has granted a franchise to R. B. Flanagan and others for the establishment of an electric light plant.

Spartanburg, S. C.—The capital stock of the Spartanburg Gas, Electric Light and Power Company has been increased to $75,000.

Point Pleasant, W. Va.—D. S. Snyder and others are interested in a movement looking to the establishment of an electric light plant.

Seymour, Tex.—The contract for the erection of the new electric light plant has been awarded to O. J. Gorman & Co., of Houston, Texas.

Roanoke, Va.—Work on the new electric car line between Roanoke and Vinton is progressing rapidly. The wires are now being put up.

Augusta, Ga.—The Augusta Railway Company has ordered additional electrical equipment for an extension of its electrical line to Monte Sano.

Chester, S. C.—An isolated system of incandescent electric lights has been installed in the cotton mill of the Chester Manufacturing Company.

Dawson, Ga.—A company with a capital stock of $30,000 is being organized by C. G. Barfoot and others to build and operate an electric light plant.

Jacksonville, Fla.—The Jacksonville Electric Railway Company has been incorporated by J. Q. Burbridge, J. W. Schumacher, F. F. L. Engle and others.

Newport News, Va.—The annual meeting of the stockholders of the Newport News Light & Water Company will be held at the company's offices on Dec. 3.

Comanche, Tex.—A company is being organized by C. E. McCullough and others to establish several enterprises, among which is an electric light plant.

Hagerstown, Md.—New machinery is being put into the plant of the Hagerstown Electric Company, and the system has been very much improved thereby.

Winston, N. C., is to have another electric line, so it is said. The Winston Land and Improvement Company proposes the construction of an electric street railway.

Water Valley, Miss.—The city council has awarded a contract to the Thomson-Houston Electric Company, of Boston, Mass., for the erection of an electric light plant.

Bay St. Louis, Miss.—The Bell Electric Light Company is erecting an electric light plant for the Gulf Coast Ice and Manufacturing Company, recently organized.

Houston, Tex.—The Houston Electric Street Car Company has been granted a franchise to operate an electric street railway through the streets of that city for 35 years.

Port Deposit, Md.—The plant and buildings of the Port Deposit Electric Light Company were recently destroyed by fire at a loss of $5,000. The plant will be rebuilt, it is stated.

Beaumont, Tex.—The City Council has granted a franchise to the City Street Car Company for the construction of an electrical railroad, upon which work will be commenced at once.

Asheville, N. C.—An electric line from one to three miles in length will be built, with either trolley or storage system, by the Asheville Loan Construction and Improvement Company.

Kingwood, W. Va.—A contract has been awarded the Edison Electric Light Company for the erection of an electric light plant for street illumination, as well as for commercial purposes.

Carrollton, Ga.—The plant of the Carrollton Electric Light Works has been finished and the light was turned on a few days ago. Over 500 lights were taken and many more are being put in.

Will Work at Night.—At Argenta, Ark., the Elite Furniture and Lumber Company is preparing to install an isolated incandescent system of electric lights in its furniture factory and lumber mills.

Ashville, Ala.—A company with $10,000 capital stock has been organized to establish an electric light plant, and a contract is reported to have been awarded a Chicago house for the putting in of the installation.

Alexandria, Va.—Washington capitalists have incorporated the Hubbell Electric Light and Power Company, with a capital stock of $100,000. The officers are: I. Saks, president; George Moss treasurer; E. Sutherland, secretary.

Hagerstown, Md.—An electrical railway, four miles in length, will be constructed by the Hagerstown Street Railway Company, which has just been organized, with C. W. Sebold as president, S. M. Shindel as vice-president, and J. D. Main, secretary.

Elberton, Ga.—The present session of the Georgia Legislature will be petitioned for a charter, incorporating the Elberton Electric Light Company. Messrs. Swift, Wilcox and Broswell are among the incorporators. This firm desires estimates on an electrical equipment.

Fort Worth, Tex.—The Fort Worth Light and Power Company is rapidly completing its $270,000 buildings, and hope to have everything in readiness to commence operations in a few months. This plant will be large enough to supply a city of 400,000 people, and is probably the finest and largest in the Southern states.

Old Point Comfort, W. Va.—A company has been organized to operate an electric light line from Old Point to Hampton, and contracts have been awarded to the Johnstown Company, of Johnstown, Pa., for the material necessary for the construction and equipment of the road. This road will be extended to Newport News during the coming summer.

Johnston, S. C.—The Johnston Telephone Company, with a capital stock of $1,000, has been incorporated, to construct a telephone line from Johnston to Augusta, Ga., along the public highway via Pine House, Old Wells, Vancluse, Graniteville and Langley. The incorporators are: W. M. Hazel, H. W. Crouch, R. A. Turner, W. G. Hernaghan, J. W. Smyly, P. L. Wright, S. J. Watson, C. D. Kenney.

Louisville, Ky.—There is a likelihood of this city having two new electric light plants. The city has awarded the Louisville Gas Company the contract for lighting the city, and that company will erect an electric light plant. The Gooch Electric Light Company has been incorporated by W. T. Grant, J. J. Harrison, Dexter Belknap and others, and they propose establishing an electric light, heat, and power plant.

Death of a Telegrapher.—Mr. Jerome Williams, formerly night chief of the Western Union Telegraph Company's office at Charleston, S. C., but more recently chief operator of the Postal Telegraph Company's office in that city, died a few days ago at his residence in Charleston. Mr. Williams was a native of Charlotte, N. C., but had lived in Charleston several years. He was a very popular man, a master Mason, and was buried with Masonic honors.

A Telegrapher's Funeral.—Mr. W. R. Hammond, an operator of the Postal Telegraph Company, at Richmond, Va., died recently and was buried by the Junior Order of American Mechanics, of which he was an active and popular member. Among many handsome floral designs at the funeral was one representing a broken circuit—two telegraph poles with a broken wire—also a pillar with 30, which in telegraphy means "no more," and the letters "H. A.," the dead man's telegraphic signature, both sent by the telegraphers of the city.

Another Telegraph Case.—The following is a recent decision handed down from the Supreme Court of the State of Georgia in the case of the Western Union Telegraph Company vs. Cooledge. The question is one of damages, and involves constitutional and statutory law. The judgment of the lower court was affirmed, as follows: "1. The act of Nov. 12, 1889, as to telegraph companies (acts of 1888–89, p. 175) does not repeal the act of Oct. 22, 1887 (acts of 1886-87, p. 111), relating to the same subject matter. (a) It seems that the first-named act is in violation of that provision of the constitution which prohibits any act of the Legislature containing more than one subject matter. (b) It also seems that this act, so far as it conforms to its title, applies only to such telegraph companies as might construct their lines after the passage of the same. 2. This not being an act for damages, but an action to recover a penalty under the statute of Oct. 22, 1887, the conditions printed on the blanks of defendant below, requiring all claims for damages on account of sending the dispatch to be made in writing within 60 days, do not apply."

Richmond, Va.—A special meeting of the Electric Light Committee of the City Council was held recently to receive bids for furnishing 134 street electric arc lights of 1,200 actual candle power each for a term of one year or less from February, 1891. Capt. Andrew Pizzini, Gibson Putzel, of New York; Windom R. Meredith and Superintendent Trafford, all of the Richmond Railway and Electric Company, and General Manager Traylor, of the Traylor Electric Company, were present. A proposal was submitted by the Richmond Railway and Electric Company agreeing to furnish the desired number of lights of the required candle power at the rate of 13½ cents per light per night. The Traylor Electric Company also submitted a proposition to furnish the same lights for 24 cents per night. These were the only bids received. The Richmond Railway and Electrical Company is practically the same corporation that is now furnishing the city with electric lights. The price now charged is more than double that bid by that company, being 40 cents. This is believed to be the lowest price on record for electric lights. It was decided that a $1,000 bond should be required for the faithful performance of the contract. Capt. Pizzini stated that if his company made a cent on this contract it would be one cent more than they expected. The full 134 electric lights are now in operation every night. After several weeks' vacation for 34, which it will be remembered were recently ordered down by the electric light committee, and which action was so severely criticised by almost the whole city, the action of the committee necessitated the lighting of over 100 gas lamps, throwing an additional expense on the gas department for the manufacture of 250,000 additional cubic feet of gas per month. On investigation, it was found that there was absolutely no economy in this procedure, and the only difference was that instead of paying out money on account of the electric lights, it had to be paid for gas, with poorly-lighted streets.

WASHINGTON, D. C., Nov. 29, 1890.

An Election of Officers.—The newly-elected board of directors of the United States Electric Lighting Company of this city has elected officers as follows: A. A. Thomas, president; Wm. E. Clark, vice-president; Seymour Tullock, treasurer; Chas. C. Duncanson, temporary secretary; A. A. Renshaw, general manager.

Official Endorsement of Electrical Execution.—Chief Justice Fuller, in the United States Supreme Court, a few days

ago, announced the decision of the court in the case of Jugigo, th Japanese sailor, under sentence of death by electricity at Sing Sing. The decision sustained the court below, deciding that the New York electrocution law is constitutional on the grounds taken in deciding the case of William Kemmler.

An Electric Light Company Permit.—The Commissioners of the District of Columbia have granted permission to the United States Electric Lighting Company to lay an underground conduit in the carriage-way of Fourteenth street, West, between New York avenue and B street, North; also to place distributing poles in the alleys of all squares abutting on Fourteenth street and to connect said distributing poles with the underground conduit mentioned.

A Big Electric Light Plant.—Bids were opened this week at the War Department, in the office of Capt. Thomas Williamson, Superintendent of the State, War and Navy building, for the materials for the establishment in that building of a complete plant for electric lighting, thus completing the structure and making it the finest of all government buildings. The contemplated plant is intended to furnish electric illumination for the White House and grounds. When this building was turned over to the three secretaries by Gen. Casey, two years ago, he reported it to be completed, but, after consultation, Secretary Endicott came to the conclusion that no modern office building should be considered complete until provided with a full outfit for lighting with electricity, and he accordingly made an allotment out of the money left for the original appropriation, amounting to about $60,000, for the purpose of wiring the west and centre wings, the others having already been wired by the Electro Lighting Company, with the understanding that the government might purchase the wires when it so desired at a certain price. As it turned out, this price, it is stated, was far below the actual cost of wiring, so that the Government is now, without any intention on its part, a good deal the gainer in the transaction. There was but one bid for the dynamos, inasmuch as the advertisement called for Edison dynamos, which have been proven successful, and for which there is a necessity in this case, as other portions of the Edison system are now and have been in operation in the building for three years past, and the purchase of these dynamos will simply complete the system then established. The bids were as follows: From the Edison General Electric Company, of New York, for four dynamos, erected complete, $7,600; from E. P. Hampson, & Co., of New York, for two engines, $4,225; from Hoover, Smith & Co., of Washington, for two engines, $1,587; the same firm, for three boilers, $3,543; from the Southwark Foundry and Machine Company, of Philadelphia, for three boilers, $3,520. No awards have been made up to this date, but it is probable that the contracts will be given almost immediately in order that there shall be no delay in the beginning of the work. The entire plant will probably cost within $25,000, and will, when completed, not only light the department building, but the President's mansion, as already stated. The union of the two buildings was for economic reasons, it being estimated that there will be a great saving when the White House takes up the current during the night, at the time when the office building is not using it. The actual cost of the lighting of the executive mansion will be charged against the commissioner of public buildings and grounds, who is in charge of the White House, and who will pay the superintendent of the other building the proper sum each month or quarter, to constitute a part of its contingent fund. Thus the White House will get cheap lights, and the expense of running the plant will be lessened. At the present time there are about 1,600 lights used in the State, War and Navy building. There are to be about 750 lamps in the White House, and these will make a total of 2,350 lights on the circuit. As the estimate is for a double plant of four dynamos, and the intention is to run but two of them at a time, provision is thus made for a total capacity of about 2,880 lamps. Even if all the lamps should be lighted at once, which will probably never happen, it will be possible to start both pairs of dynamos, and thus give a strong current to all. During the day there is need for only about 800 or 900 lamps in the department, although these vary, as the weather condition outside changes; the White House will need its illumination only at night. It is desired to complete the work by the end of December, so as to be able to turn on the current for the New Year's reception. It is expected that all the fixtures will be in place at the White House by then, and if the plant should be delayed in any way, the lamps will be run from the city circuit. The wires connecting the two buildings run through the greenhouse and along the brick wall at the west end of the White House grounds, through four neat standards, thence down into the ground, thence across the street to the department side by means of a small tunnel, work on which is to be begun at once. The dynamos and engines are to be located in the centre wing of the building, in the sub-basement, where there will be no noise to reach the clerks above. V. N. B.

ENGLISH NOTES.

(*From our own Correspondent.*)

LONDON, Nov. 19, 1890.

The London-Paris Telephone Line.—The land lines on either side of the Channel in connection with the Paris telephone wire are now completed, and the special telephone cable itself is under construction. If all goes well it is anticipated that public telephonic communication will be possible by the middle of February. At the present moment the question of tariff is under consideration by the authorities on either side of the Channel, and the figure at present suggested is 20 francs for five minutes' conversation. It is anticipated that something like 100 conversations will be held per day.

Gas vs. Electricity in Paris.—The Paris Gas Company which is seeking the extension of its concession from 1905 to 1930, has been in negotiation for some time past with the various authorities concerned. At the present moment, in return for the renewal of its concession, the gas company agrees to reduce the price of gas from 7s. 6d. to 6s. 3d. per thousand, and to distribute one-half of its profits to its consumers, when its profits exceed £1,520,000. The revised concession also contains a clause authorizing the gas company to exploit any system of lighting and heating whatsoever including the electric light and other applications of electricity. In England the gas companies have shown some alarm at the slow rate of increase of the gas consumption, but I think that the Paris Gas Company is one of the first of the important European gas companies to show a visible decline in this respect. A decline, moreover, which is distinctly due not only to the increase of oil lighting, but of electric lighting. For the first nine months of the present year the Paris Gas Company's receipts show a diminution of three per cent. compared with the corresponding nine months last year. The decreases for August and September of the present year, as compared with the same months last year, are respectively eight and six per cent.

The Board of Trade and the Supply of Electricity.—At a recent meeting of the Electrical Trades Section Committee of the London Chamber of Commerce, the burning question of Rule 33 of Board of Trade regulations for "securing the safety of the public and insuring a proper and efficient supply of electrical energy" was again discussed at great length. This much-objected-to rule stipulates that every high-pressure aerial conductor is to be continuously insulated with a durable and efficient material, to be approved of by the Board of Trade, to a thickness of not less than one-tenth of an inch, and in cases where the difference of potential exceeds 2,000 volts, the thickness is to be $\frac{\text{number of volts}}{20{,}000}$. When the rules first appeared this particular clause evoked great opposition, and memorials were sent in by individual supply companies urging the Board of Trade to reconsider this point, as the result was the production of what Mr. Crompton very appropriately termed a "pudding." To the petitions of the Electrical Trades Section Committee and the individual companies the Board of Trade only vouchsafed the reply that "these rules before being published had been submitted to the Council of the Institution of Electrical Engineers, whose members were men of the highest scientific attainment," and that they could not see their way to revise the rules, as requested. At the meeting of the Electrical Trades Section Committee on Monday Mr. Crompton pointed out that conductors, even for the smallest working current, if protected in the manner required by the Board of Trade, could not be produced for less than £78 per mile, or nearly three times the price of a well insulated conductor of the ordinary description. It was also pretty generally the opinion of the meeting that these Board of Trade conductors, owing to their enormous mass of insulation, weight and regulation mode of suspension were likely to prove far more dangerous to the public than ordinary insulated wires. It was also pointed out by Mr. Swinburne, that Rule 18 still stipulated that transformers on the consumers' premises should be "completely inclosed in solid walls or in *strong metal casing*." This proviso he pointed out seriously interfered with the use of open circuit transformers, such as the "Hedgehog," and that although the matter was at the present moment a somewhat personal one, he thought that at no distant date it would have a more general interest for the industry. Considerable indignation and astonishment was expressed that such rules should ever have been framed without consultation with those concerned. After the reading of the somewhat curt reply of the Board of Trade to a previous communication by the committee on this subject, it was promptly decided to take immediate steps with a view of obtaining the support of the whole council of the London Chamber of Commerce in urging upon the Board of Trade the desirability of paying some attention to the wishes of the electrical industry.

News of the Week.

THE TELEGRAPH.

New Building.—The Western Union Telegraph Company has submitted plans to the Building Bureau for an office building to be erected at Nos. 8, 10 and 12 Dey street, this city. The building is to be an eleven story structure, 167 feet high, and the cost will be $150,000.

A Cable from Canada to Australia.—A dispatch from Ottawa, Can., says that information has just been received of the second season's work of H. M. S. "Egeria," a man-of-war, deputed to make an examination of the bed of the Pacific Ocean, with the object of discovering the best route for a cable from Canada to Australia. Last year was spent at Auckland, New Zealand, and the Fiji group. The deepest sounding obtained south of the equator was 4,530 fathoms. Unfortunately, the nature of the bottom at this great depth was lost through the wire parting when heaving in. Three islands of the Phœnix group were surveyed in sufficient details to ascertain their suitability for a telegraph cable. The vessel is now further engaged with the survey of the work, and the British flag has been hoisted on all islands visited in the Pacific which are not under the protection of any other power.

A Suit Against a Telegraph Company.—W. H. Chase, of Atlanta, Ga., recently brought suit against the Western Union Telegraph Company for $5,000 for negligence in the delivery of a telegram. He wired his sister at Washington, Ga., asking the condition of her husband, who was critically ill. He requested the telegraph company to send the answer promptly to a certain place, explaining the circumstances of the case. This they promised to do; but notwithstanding the expected message arrived within an hour of his departure from the office, it was not delivered until the following day, and the plaintiff did not reach his sister until 15 hours after the death of her husband. The defendant's attorneys entered a demurrer to the petitioner's plea, holding that the wounding of the private feelings of the plaintiff did not constitute a sufficient ground for a suit for damages; that he suffered no monetary loss, or loss of reputation or respectability, and consequently had no foundation for his suit. The court sustained the demurrer and discontinued the case.

THE TELEPHONE.

Increase of Subscribers.—The northwestern division of the Erie Telephone Company made a net gain of 20 subscribers in October, and the South Texas division 47, making a total net gain for the entire territory of 125.

Telephony in Sweden.—The Swedish telephone management has devoted 1,600 kronen toward the expenses of sending an expert to visit Holland, England, and America, with the view of ascertaining the latest improvements made in telephony in the several countries.

Changes in Mexico.—A dispatch from the city of Mexico to the Boston *Herald* says that the government will grant the Mexican Telephone Company four months' time in which to make application for a new concession, and in case this is granted shorter poles and aerial cables will be required, making the change a costly one.

Interference from Railway Lines.—The Central District and Printing Telegraph Company, Pittsburgh's telephone corporation, has announced its intention to proceed against several of the electric street railway companies of the city, the lines of which it is claimed have very seriously affected the efficiency of the telephone service.

A Telephone Company Not Restrained.—Vice-Chancellor Bird last week refused the application of the State of New Jersey for an injunction to restrain the Pennsylvania Telephone Company from doing business in New Jersey. The application was made because the company refused to pay $3,643 taxes which they claimed was on business done partly in New Jersey and partly in an adjoining State, and therefore came properly under the head of interstate commerce. The company's line runs from Scranton to New York.

Obstruction of Highway by Telephone Companies.—In the case of Roberts vs. the Wisconsin Telephone Company, the Supreme Court of Wisconsin has decided that telephone or telegraph companies have a right to construct and maintain lines, with all necessary appurtenances, along public highways provided that the lines and appurtenances shall not at any time obstruct or incommode the public use of the highways, and no cause of action or for damages will arise unless an obstruction is proved. Where a team of horses was frightened and ran into a telephone pole and the driver was thrown out and injured, as the location of the poles did not obstruct or incommode the public use of the highway he has no cause for action.

November Business.—The monthly report of the output of instruments by the American Bell Telephone Company makes the following comparisons:

November:	1890.	1889.		
Gross output	5,318	3,763	Inc.	1,555
Returned	2,926	2,929	Dec.	3
Net output	2,392	834	Inc.	1,558
Dec. 21 to *Nov.* 21:				
Gross output	59,105	52,157	Inc.	6,948
Returned	25,241	22,827	Inc.	2,414
Net output	33,864	29,330	Inc.	4,534

The number of telephones now under rental by the American Bell company is 478,725, against 433,870 a year ago at this time, an increase of 38,855.

THE ELECTRIC LIGHT.

The Electric Contract Company.—A new electric lighting company has been established in Philadelphia, and has contracted with the Westinghouse Electric and Manufacturing Company for the installation of 750 incandescent and 300 arc lights.

Recent Sales.—The Western Isolated Lighting Department of the Thomson-Houston Electric Company reports the following sales made through the Chicago office for the past week: Milwaukee Car Wheel and Foundry Company, Milwaukee, Wis., 20 arc light plant; Democrat Printing Company, Madison, Wis., 100 incandescent light plant; L. E. White, Greenwood, Cal., 30 arc light plant. The order recently placed by the Union Pacific system for lighting the shops of the Denver Union Railway and Terminal Company, at Jersey, Col., with the Western Isolated Lighting Department of the Thomson-Houston Electric Company, comprises two 500-light dynamos and other appliances, including wiring, necessary to operate 1,100 incandescent lamps, and a 600-light generator, which will be used in connection with an electric motor for operating a transfer table.

An Oregon Water Power Plant.—The Willamette Falls Electric Company, of Portland, Ore., is making some additions to the capacity of its electric lighting plant. The central station was put up more than a year ago, and was installed with Westinghouse alternating current apparatus of a capacity of 6,000 incandescent and 200 arc lamps. The plant is situated at Willamette, where the water power of the falls is utilized in the generation of the electric current. From the generating station to Portland is 12 miles, and for the purpose of transmitting the current over this distance the installation consists of 3,000-volt dynamos. The light and the plant in general have given great satisfaction. The demand has increased and the company has given the Westinghouse Electric and Manufacturing Company the contract for apparatus to furnish an additional 100 arc lamps.

Decision Regarding Crossed Wires.—An employé of an electric light company was injured while in the performance of his duty. He was engaged in trimming lamps upon a circuit which, under the rules of the company, should have been dead at the time he was working upon it. As a matter of fact it had come in contact, at a point where the insulation was weak, with a live circuit, and had become charged. It would unquestionably have been negligent for a company to turn a current of electricity into the circuit on which he was at work without notifying him of that fact, and it was equally negligent to permit the circuit to become charged by failing to exercise proper precautions as to the crossing of wires and the insulation, and whether the company or its officers actually knew of such defect or not, the company is bound by the effect of its own neglect and is liable in damages to a workman so injured. This decision was rendered in the case of Kraatz vs. Brush Electric Light Company, in the Supreme Court of Michigan.

Lighting of the Ashland Mine.—The Westinghouse Electric and Manufacturing Company has just completed the installation of an electric light plant in one of the iron mines of the Lake Superior district. The mine is called the Ashland, owned by the Ashland Iron Mining Company, of Ironwood, Mich. There are over 2,000 people employed in the mine, which is one of the oldest and richest in the Ironwood mining region. Like most of the mines in the Lake Superior ore belt, the Ashland is in some portions quite damp and the installation of an electric lighting plant presented a number of difficulties owing to the trouble of securing a thorough insulation of the wires. To insure good insulation the wires were drawn through Simplex insulating paint and only the best Okonite wire was used in the entire plant. The generating station of the plant is situated in the pump-house. The plant has a capacity of two 300 light Westinghouse machines. The switchboard is very artistically arranged and is made of a board of white and brown birchwood.

November Business of the Westinghouse Company.—During the month of November the shipments of the company so far amount to 40 alternating current incandescent dynamos, aggregating a total capacity of 30,000 16 c. p. lamps. To this must be added 1,200 alternate current meters. The demand for these measuring instruments of the Westinghouse Electric and Manufacturing Company has for months been particularly pressing, and the detail department, at the Garrison alley shops, where the meters are manufactured, is taxed to its utmost capacity. The same remark holds good in regard to the Westinghouse converters, the high efficiency of which has created a very favorable impression for them, wherever they have been used. The company is in almost daily receipt of letters and communications from places where the converters have been introduced, which speak in exceedingly favorable terms of their operation. As an instance of this fact, it may be cited that during the entire time in which the company has manufactured and sold these converters, according to reports, not one has ever been returned for fault of construction or inefficiency. This shows a remarkable record for a piece of workmanship.

The McKeesport Light Company, of McKeesport, Pa., figured in the Pittsburgh court the other day. The proceedings were in the shape of a petition for a writ of mandamus on Thomas L. White, acting president of the company, to compel him to call a special meeting of the stockholders. The petition was made by the Edison Electric Light Company, Samuel Insull, the Edison General Electric Company, Thomas Petty, D. A. Farley and Magnus Pflaum, stockholders in the company. They state that they own 1,055 shares of the 1,843 shares issued. The total capital stock is divided into 2,000 shares. At a meeting of the stockholders on Nov. 12, 1889, Thomas L. White was elected president of the company. At the annual meeting, Oct. 14, 1890, an amendment to the by-laws was passed increasing the number of directors from five to

seven. The petitioners state that they were ready then to elect the seven directors, but the other stockholders present, though a minority in interest, were a majority in point of numbers, and, under the leadership of Mr. White, obstructed the action of the meeting. The court is asked to issue a writ commanding Mr. White to call a special meeting of the stockholders. The hearing in the case was fixed by the judge for Nov. 29, 1890.

APPLICATIONS OF POWER.

A New Insulator.—The Central Electric Company have obtained patents on a new form of glass insulator, especially designed for heavy railroad work. It is estimated that this insulator will increase the insulation resistance of a line at least 100 per cent.

Motor in a Printing Office.—The Indianapolis *News* is rejoicing over the installation and excellent operation of a 40 h. p. Jenney electric motor that is connected to a constant potential central station circuit in service day and night. This motor turns the two big presses and drives all the other machinery in the building affording a perfect regulation f speed which is prized so highly in a printing office.

The South Covington (Ky.) Electric Railway is now in successful working order, running a mile and a half. It is operating four cars. The wires will be extended out to the Latonia race track, some three miles. This road will do a great business during the races. Latonia is one of the most popular tracks in the country. The other car company in Covington has already strung its wires, and will change from horses to electricity in a few weeks.

Jamestown, N. Y., has decided that it needs a street railway and a number of gentlemen interested in the scheme of a railway system for the town visited Pittsburgh a few days ago to take a look at the Westinghouse shops and to observe the practical operation of other electrical railway systems in that city. They expressed themselves as being much pleased with the things they saw, and it is altogether likely that Jamestown will soon have rapid transit.

An Efficiency Test.—Just after six o'clock on a rainy night last week a motor car drawing two trailers on the Union Depot line in St. Louis met with an accident that rendered assistance necessary. In less than five minutes a second motor car drawing two trail cars came along and coupling to the rear car of the disabled train pushed these three cars in front and pulled its own train up the grade at the depot and out to the end of the line without any difficulty, although every car was crowded with passengers returning home from their day's work.

Water Power for Electric Railways.—Mr. William A. Traill has written to Mr. T. C. Alcott & Son, of Mount Holly, N. J., from the engineer's office of the Giant's Causeway Electric Railway in the North of Ireland, to say that the two 27-inch Alcott turbines which were supplied to that railway in 1883, and were then put in operation, still continue to give excellent satisfaction. They have been in constant use driving dynamos for the electric railway, which is eight miles long, since that date, and usually run from 15 to 18 hours a day. The repairs he says have cost nothing, and the wheels are in as good working order to-day as when first installed.

The Second Avenue Electric Railway Company, of Pittsburgh, wants to reach the suburban town of Homestead, situated upon the Monongahela River, on the south side of that stream, about nine miles from the city. In order to reach Homestead, the Second avenue company will be obliged to bridge the Monongahela, but the management of the company has decided that this is not too great an undertaking, and accordingly an application will be made to the Governor on Dec. 4 to erect a bridge at Glenwood, midway between Pittsburgh and Homestead. The officials of the Second avenue company say that when their line is completed it will form the most direct route to the city and that the time consumed in making the trip need not exceed three-fourths of an hour.

A new Snow Plow, to be utilized upon electric street railways, is now being manufactured by the Westinghouse Electric and Manufacturing Company in connection with its system of electric street railway motors. The appliance differs in several respects from the old-fashioned cylindrically-shaped broom, revolving beneath the body of a truck. It consists of an ordinary car truck equipped with two motors, one of which propels the car, while the other is used to revolve two sets of shovels. These shovels are encased in a circular box, which is attached to the front of the truck, and is so designed that it glides closely over the rails. As the snow plow moves along all the snow on the rails is picked up by the circular box. The revolving of the shovels brings the snow to the top of the case, where it is discharged through a spout. This spout can be adjusted with the opening turned toward either side of the car. The plow is said to have a very neat appearance.

The Duquesne Traction Company is gradually obtaining from the city of Pittsburgh rights which will be of great value to it. At a late meeting of the City Council rights over several downtown thoroughfares were granted to the Market street railway and the Grant street railway, both of which are to form adjuncts to the Duquesne Traction Company's line. Still another ordinance was passed granting the Duquesne company the right to use the streets now utilized by the Central Passenger Railway Company and the Transverse Railway Company, upon the consent of those companies. The work of constructing the lines of the Duquesne company is going rapidly forward, and is nearing completion at most points. At Wilkinsburg, the terminus of the line, seven miles distant from Pittsburgh, it is necessary to tunnel under the Pennsylvania Railroad, and this necessity has been causing some of the delay. But the tunnel is now under way, and will be finished before the last day of the present year, if all goes well.

PERSONALS.

Mr. Henry Villard, president of the Edison General Electric Company, arrived in this city last Saturday from Europe.

Mr. Geo. B. McCormick has resigned his position as assistant superintendent of the Edison Electric Illuminating Company, of West Chester, Pa.

Mr. F. S. Pearson, chief of the steam and electrical departments of the West End Street Railway in Boston, has been chosen by President Lewis of the Brooklyn City Railroad as consulting electrical engineer of that company.

Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, has been announced to deliver a lecture before the members of the Department of Electricity of the Brooklyn Institute on Dec. 5 on "Electrical Engineering: Its History and Future Possibilities."

Mr. Hubert S. Wynkoop, M. E., assistant district engineer of the central district of the Edison General Electric Company, has been transferred to the Pacific district of the same company at San Francisco. Mr. Wynkoop's new position is not positively defined as yet, but will at least be one of authority in the engineering department.

MISCELLANEOUS NOTES.

The Stiger-Newhall Electric Light Company has been incorporated at Chicago, Ill., with a capital stock of $20,000; incorporators, C. W. Stiger, Walter C. Newhall and Charles A. Buel.

The Monticello Supply Company has been incorporated at Monticello, Ill., to supply electric light and power, water, and steam heat. Capital stock, $15,000. Incorporators, W. E. Smith, Reber Huston and H. E. Huston.

Okonite Souvenirs.—The handsome little special circulars gotten up by the Central Electric Company, exhibiting a piece of Okonite wire that has been in use for five years, and which was referred to in these columns in a late issue, have attracted much attention, and the company has received numerous applications for specimen circulars to be kept as souvenirs.

Industrial and Trade Notes.

The Jewell Belting Company, of Hartford, has about completed its elegant new offices, and callers can now have the choice of a nice sofa or easy chair and can have, as before, the pleasure of being agreeably entertained.

Steele & Johnson, of Waterbury, Conn., are rushed with work for electrical people. This company has just finished and moved into its elegant new offices, and the members of the firm would be glad to have all their old friends call.

Large sales of the celebrated Sunbeam incandescent lamp are continually made by the Electrical Supply Company, of 171 Randolph street, Chicago. In addition to the Sunbeam, this company is handling the Edison lamps, the merits of which are well known, and expects to dispose of large quantities of them.

Mr. F. B. Aspinwall, 121 Liberty street, this city, has sold to the Newark Electric Light and Power Company two 8-inch and two 10-inch Lyman & Warren improved exhaust heads, and to the Morristown Electric Light Company one 8-inch head. The sales of these heads are reported by Mr. Aspinwall to be steadily increasing.

The Kirkwood Grate Bar Company, 187-189 Mercer street, this city, is putting in one of its grates for the Cooperstown (N. Y.) Illuminating Company, one for the Gloversville (N. Y. Electric Company, one for the Hackettstown (N. J.) Electric Light Company, and one for the Madison Square Garden plant in this city.

The Dunham Manufacturing Company is making a specialty of the manufacture and sale of patent devices for railway construction and equipment. The push and energy, meritorious articles handled, and systematic and artistic advertising of this company have brought it prominently before the railroads of the United States and Canada.

The Swain-Goodsell Metallic Packing Company, 139 Lake street, Chicago, are sole owners and manufacturers of the "Swain" metallic packing, which is claimed to be the most sensible article of the kind. The company is becoming well and favorably known to packing users, and at present reports being crowded with orders for this specialty.

A Good Insulation Test.—The Highland Park (Ill.) Electric Light Company has adopted improved Candee wire for its primary circuits throughout the system, and has over 15 miles of it in use. The company reports that recently, after three days of continuous rain, a test showed that the insulation resistance of the primary circuits was over one megohm, notwithstanding the fact that the wires are built through alleys, and in a great many cases hang through trees.

The Central Electric Company, of Chicago, reports a continually increasing demand for improved Candee wire, and in order to meet this demand has stocked its warerooms with a larger quantity than ever. As an instance of the company's facilities for doing business in a hurry, it may be noted that it received an order last week for 12,000 pounds of this wire to be shipped at once, and it is said that the wire was at the freight depot in less than one hour after the order passed through the office.

Wainwright Expansion Joints.—The Newark Electric Light and Power Company has placed an order for four 8-inch and one 10-inch Wainwright corrugated copper expansion joints for its new station in Newark with the New York manager of the Wainwright Manufacturing Company, of Massachusetts, Mr. F. B. Aspinwall, 121 Liberty street, this city. This company has just equipped the power house of the West End Street Railway Company, of Boston, with all the expansion joints used in the plant, amounting to over $2,500. It is reported that the sales of this joint, especially for use in electric light stations, are very largely on the increase, both in new plants and in the remodeling of old ones.

The Wainwright Company of Massachusetts sold 50 heaters last month aggregating 5,800 h. p. The following are some of the more recent sales: Jasper County Electric Power Company, Webb City, Mo., one 300 h. p.; Lewistown Electric Light Company, Lewistown, Pa., one 100 h. p.; Western Electric Company, Chicago, one 30 h. p.; Edison Electric Illuminating Company, Mt. Carmel, Pa., one 100 h. p.; Kennelworth Illuminating Company, Asheville, N. C., one 75 h. p. For several weeks trouble has been experienced at the State fair on account of the steam pipes at the joints. About three weeks since a Wainwright expansion joint was put in on one side. Last week the regular joint on the other side burst creating havoc, but the Wainwright stood the test and the company's joint will at once be adopted.

Mr. George Cutter, who is so well known to our readers from the success with which he has designed and handled electric specialties, is again in business for himself. Having leased a suite of rooms in the Rookery at Chicago, he will soon be prepared to supply the best appliances for electric light and power work. He already controls a number of excellent devices, and is making arrangements for pushing others of equal merit. Thanks to his large experience in various lines of electrical work, he is enabled to see the need of improved appliances and has had marked success in supplying devices which exactly filled the want. Besides making and handling such specialties, he will act as consulting electrician, a work for which he has for a long time shown himself well fitted. With a man of such experience, and with the able corps of assistants, it is safe to predict a most promising future for George Cutter's new house.

The Crosby Electric Company, 87-89 South Fifth avenue, New York, has its large sales and exhibition rooms well stocked with its dry batteries, as well as the Hussey batteries for open and closed circuit work. This firm had a large exhibit of its specialties at the American Institute Fair, among which were four of the Hussey closed circuit batteries running a large Pailliard music box. The company also had its open circuit batteries doing all kinds of service that an open circuit battery could be called upon to perform. Their improved Hussey blue vitriol battery for closed circuit work was used in running ventilators, fans and sewing machines; also for charging storage batteries for general service. A very neat and novel advertising scheme of this firm is the artistic manner in which it has its various batteries painted on the store windows at the South Fifth avenue salesroom. The interior of the salesroom is made very attractive, and the display of goods shows excellent taste. They have devised many forms of open circuit batteries from which one can get two, four, six, eight, or any other voltage required, in compact form, for any class of work for which an open circuit battery is used, especially in the electro-medical line.

The Chicago Electric Manufacturing Company has a thoroughly equipped factory at 73 West Jackson street, Chicago, where it is making a specialty of the manufacture of electric light accessories and the development of new electrical devices. Although but just started, the company has secured contracts for work that will keep the factory operatives busily occupied for the next four months, and insure the success of the enterprise from the start. The machinery is all new; the firm has an abundance of small tools, lathes, chucks, and everything requisite for quickly turning out any work in its line that may be brought to it. The company will make a specialty of carrying in stock a complete line of vulcanized insulating material, which will be cut to order for the trade, and will also carry zinc, brass and copper bars and strips in large sizes to be reduced in size as ordered. Some extra heavy switches for high ampère currents are now being made, besides some special automatic cut-outs for storage batteries and a very simple but efficient connector for any form of storage battery terminals. One feature of importance in connection with this company's plant is a fire-proof vault of large size in which are placed all designs, models and drawings when they are not in use.

The Coe Brass Company, of Torrington, Conn., now employs some 600 men. The factories of this company are probably the finest of any in New England; the motto of the founder, Mr. L. W. Coe, being, "If it is necessary to have a thing, get the best." The company is now building two additions, one 200 × 160 of stone (like all its factories) with the finest marble trimmings. This will be used for drawing tubes and rods for gas lighting, electrical use, etc. The power for this addition is furnished by a 500 h. p. triple-expansion Watt-Campbell engine. Five hydraulic pumps will run the machinery for drawing tubes. Twenty-five Thomson-Houston arc lights will furnish illumination and two Sturtevant blowers and pipes will do the heating. The iron structural work was done by the Berlin Iron Bridge Company and the belting was furnished by the Jewell Belting Company. The heavy shafting and hangers were put up by Poole & Son. Taken altogether, it is a model of strength and beauty. The other addition will be similar outside, with slight changes inside, as it is to be used as a casting foundry for casting tube castings. This addition is 130 × 60. This company is now manufacturing all kinds of brass work, including tubing sheet and rolled metal, etc., and is also a large manufacturer of zinc rods and fuse wire. The combined factories are under the superintendency of Hon. E. J. Steele, whose ability has been recognized both by the State and in the National Council of the Grand Army.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Laminated Armature.—Can a laminated armature with projecting lugs of iron be manufactured without interfering with any one's patent? J.

The patent on the laminated armature is claimed by Weston, although the device is known to have been used abroad nearly 20 years ago. Most of the patents on this subject have been issued to Weston, and if you desire to look further into it, you could secure copies of them. There has been comparatively little attempt to force these claims however.

Changing Brushes.—Why does changing the position of dynamo brushes increase or diminish the current? INQUISITIVE.

Because, shifting the brushes to a fresh position on the commutator, collects the current from points differing in potential from those at which the brushes were originally placed. The potential being different, the current will also be changed. In some arc machines this shifting of the brushes is the means taken to regulate for constant current by thus changing the electromotive force in accordance with the demands of the external resistance.

A Few Queries.—(1) What is the electrical conductivity of aluminium as compared with copper or silver? (2) What kind of sheet iron would make the best field magnets for a small dynamo or motor? (3) Is there any place where small field magnet forgings could be obtained? C. J. T.

(1) The conductivity of aluminium is little less than half that of copper or silver if in bars of equal cross section. (2) Any good soft charcoal iron. (3) You can obtain rough forgings at many large machine shops. For finished drop forgings the number of manufacturers is much more limited. J. H. Williams & Co., of Brooklyn, N. Y., do considerable of this sort of work.

Coupling Compound Dynamos.—(1) What would be the probable effect of connecting in multiple two compound Edison dynamos without an equalizer? (2) What is the province of an equalizer bar, and what fuse, if any, should be inserted in it? A. J. H.

(1) Do not connect two compound dynamos in multiple without an equalizer, under any circumstances. You can readily see the result of coupling without this device, since, if either one of the machines should take more than its share of the work by reason of slightly higher voltage, the current from it, passing through the series coils of the other machine, would tend to weaken its field magnets and hence to still further increase the disparity of load. (2) The object of the equalizer bar is to allow the current from the machine which chances to give the higher voltage to pass around the series coils of the other machine in such direction as to strengthen its field, and consequently to equalize the load between the two dynamos. The equalizer bar should be of very low resistance, and is frequently used without fuses, as the cut-outs in the other part of the circuit ought to be amply able to protect the machines. If any fuse at all is inserted, care should be taken not to bring any perceptible resistance into the equalizer bar by inserting a fuse that in most cases will have to carry only a very light current. The better adjusted the two machines to work together, the less work will have to be done by an equalizer and the more satisfactory will be the running.

Business Notice.

Battery Cut-out, Cheap.—Sensitive, reliable, never require attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

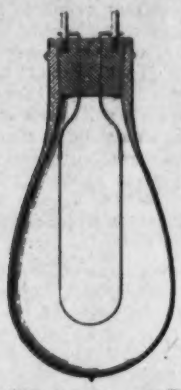
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS

U. S. PATENTS ISSUED NOV. 18, 1890.

441,122. Contact Trolley for Electric Railways; Norman C. Bassett, Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed July 21, 1890. The combination of a trolley movable toward and away from an overhead electric-supply conductor with which it is designed to make contact, with a spring normally acting upon the trolley to press it against the conductor, and intermediate connections furnishing means for automatically freeing the trolley from the action of the spring upon jumping the conductor.

441,123. Trolley for Electric Railway Cars; Norman C. Bassett, Lynn, Mass. Application filed July 26, 1890. The invention consists of the combination of the pivoted trolley for electric railway cars and a spiral spring or springs connected thereto and normally held under tension by a catch, whereby the trolley is pressed into contact with a suspended conductor, with means for automatically relieving said spring of tension and allowing the trolley to drop when the latter jumps the conductor.

441,127. Manufacture of Incandescent Electric Lamps; Adolph Bornholdt, Brooklyn, N. Y. Application filed March 19, 1890. The process of creating a vacuum within an electric light bulb or other vessel, having a gravity stopper, which



No. 441,128.—INCANDESCENT ELECTRIC LAMP.

process consists in first placing each vessel in inverted position into a vacuum cylinder, and then while the gravity stopper is open withdrawing the air from the vessel and in then inverting the vessel, thereby causing the gravity stopper to drop to its seat, and in thereupon admitting atmospheric air to the outside of said vessel.

441,128. Incandescent Electric Lamp; Adolph Bornholdt, Brooklyn, N. Y. Application filed March 19, 1890. The invention consists in supplying a stopper with a tubular passage leading from the outer to the inner end of said stopper, said passage having a support for a secondary stopper and means for limiting the movement in both directions of said secondary stopper.

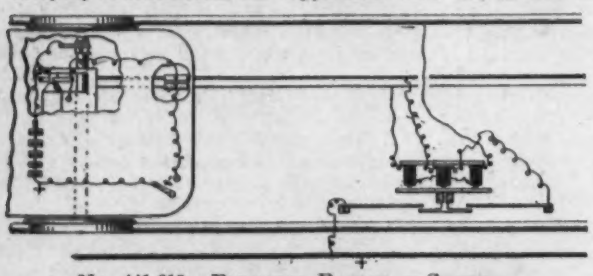
441,130. Electric Battery Connection; Horatio J. Brewer, New York, N. Y. Application filed Sept. 5, 1890. In an electric battery, the combination, with a carbon element, of a zinc connection therefor, the said connection being separated from the element.

441,157. Electrical Call, Lighting and Alarm System; Charles A. Hale, Cleveland, O. Application filed Dec. 28, 1889. In an electrically operated system for buildings, an alarm switch-board located in a central station or office, room bells, electrically connected with said switch-board, a floor-switch constructed to switch out one or more floors connected with said bells, and a battery in circuit with said parts.

441,210. Electric Street Railway System; Malone Wheless, of Nashville, Tenn., Assignor, by direct and mesne assignments, to the Wheless Electric Railway Company, of Alexandria, Va. Application filed March 15, 1890. The combination of a continuous power-line, a trolley-line composed of sections insulated from one another, a car having thereon a motor-circuit in electrical connection with the trolley line, a local circuit, part of which containing the source of electricity is on the car, and a switch between the local and the trolley line and power line, whereby when the local is closed a section of the trolley line is connected to the power line.

441,211. Electric Street Railway System; Malone Wheless, Nashville, Tenn., Assignor, by direct and mesne assignments, to the Wheless Electric Railway Company of Alexandria, Va. Application filed May 3, 1890. The combination of a continuous insulated prime conductor of power line, and uncovered working conductor or trolley line in sections insulated from one another and normally out of electric connection with the power-line, a car carrying a motor and motor circuit in electric connection with the working conductor, a local circuit the source of electricity of which is on the car, a switch controlled by the local and located between the power and trolley line section for making a connection between the two, and a contact preserver between the power and trolley line section which maintains the contact after the local makes it until the car leaves the section of the working conductor.

441,212. Conduit for Electric Railways; Malone Wheless, Nashville, Tenn., assignor to the Wheless Electric Railway Company of Alexandria, Va. Application filed May 12, 1890. A



No. 441,219.—ELECTRIC RAILWAY SYSTEM.

conduit for under-ground electric railway systems, consisting of brackets made with cable-standards and spaced apart, the walls of the conduit running from bracket to bracket and spaced apart at the top, cover plates spaced apart and covering the space between the tops of the conduit walls, one of said cover plates being permanently and the other removably secured to the brackets.

441,213. Auxiliary Contact for Electric Railways; Malone Wheless, Nashville, Tenn., Assignor to the Wheless Electric Railway Company of Alexandria, Va. Application filed July 14, 1890. The combination of a car, having insulated wheels to which circuit wires are connected, and the line of rails with an auxiliary contact located between the wheels and the rails, as set forth.

441,214. Electric Railway Cut-Out; Malone Wheless, Nashville, Tenn., Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed July 21, 1890. The combination of a car, a local circuit, and part of a motor-circuit thereon with a cut-out on the car between the power circuit and local circuit, such cut-out controlled by the power circuit and controlling the local circuit, as set forth.

441,215. Insulated Brake; Malone Wheless, of Nashville, Tenn., Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed July 21, 1890. The invention consists in providing the car with a brake having means of insulation, so that the shoe or rubbing part is electrically insulated from the beam.

441,216. Electric Railway System; Malone Wheless, Nashville, Tenn., Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed July 21, 1890. A magnet, in combination with an armature, a bar pivoted thereto and also pivoted to a support, and a circuit provided with contact-plates, the ends of the bar being adjacent to the plates.

441,217. Electric Railway System; Malone Wheless, Nashville, Tenn., Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed Aug. 27, 1890. In an electric railway system, in which a local circuit operates an electro-magnetic switch in the main circuit, such local circuit having a break, in combination with a switch lever at such break, provided with a spring which normally holds the lever in the break and the rheostat in the main circuit, the lever of which crosses the switch lever, and thereby moves the switch lever against the spring.

441,218. Electro-Magnetic Switch for Electric Railways; Malone Wheless, Nashville, Tenn., Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed Aug. 27, 1890. The combination of a power line, a working conductor or trolley line in sections, a local circuit, and an electro-magnetic switch, the magnets of which are vitalized by the power line and located circuit, there being a break between the power line and the working conductor, the switch being located at this break, and said switch and the power line and working conductor being provided with carbon contacts, as set forth.

441,219. Electric Railway System; Malone Wheless, Nashville, Tenn., Assignor to the Wheless Electric Railway Company of Alexandria, Va. The combination of an insulated power line, a bare working conductor or motor trolley line in insulated sections, a bare local circuit trolley line in insulated sections, a car provided with a motor and a battery, a trolley in electrical connection with the motor and the motor trolley line, another trolley in electrical connection with the battery and the local circuit trolley line and electro-magnet switch between the power line and working conductor, the local circuit being in electrical connection with the magnet of said switch as set forth.

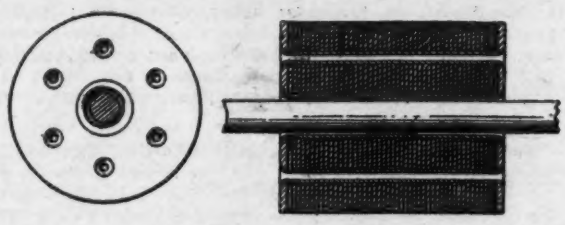
441,220. Trolley for Underground Electric Railways; Samuel E. Wheatley, Washington, District of Columbia, Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed July 21, 1890. This invention comprises a rectangular holder provided with a hole in each end in which are loosely held the stems of two concavo-convex brushes.

441,221. Conduit for Electric Railways; Samuel E. Wheatley, Washington, District of Columbia, Assignor to the Wheless Electric Railway Company, of Alexandria, Va. Application filed Aug. 28, 1890. In an electric railway system the working conductor of which is underground, the combination of an open-slotted conduit supported upon brackets, a working conductor in such conduit, supports for such conductor, and boxes separate and distinct from the brackets, and in which boxes the conductor supports are secured.

441,246. Armature Body; Charles A. Lieb, New York, N. Y. Application filed Sept. 18, 1890. An armature body comprising, essentially, a series of discs of iron and insulating material, and a tube passing through the centre thereof, the ends of which are turned over and expanded against the outermost plates or discs.

441,250. Telpherage System; James Eveleth Maynadier, Taunton, Mass. Application filed Aug. 4, 1890. The invention consists in a compound vehicle made up of a number of coils collected together to form a single vehicle by means of hollow couplings.

441,256. Dynamo Brush Clamp; Thomas Reese, Jr., Newark, N. J. Application filed July 22, 1890. The combination in a dynamo brush clamp of a rectangular frame adapted to pass adjacent to the commutator and vertical partitions in said rectang-



No. 441,246.—ARMATURE BODY.

ular frame adapted to pass between the sections of a dynamo brush with set screws in one side of said frame and brushing plates adapted to rest on the sections of said brush under the points of said set screws.

441,258. Conduit for Electric Railways; Nicholas Seibert, Malden, Mass. Application filed March 5, 1890. The combination with a railway truck of a supplemental frame suspended therefrom and having supplemental wheels, a housing containing an electric conductor, a rocking support having contacts adapted to be brought into engagement with the conductor and connections from the rocking support to the car motor.

441,293. Rheostat; John Doyle, Hoboken, N. J., Assignor to the North American Electric Company, of New York, N. Y. Application filed Aug. 1, 1890. A rheostat or resistance formed of a cylinder of earthenware having a grooved surface and resisting material in such grooves, and connections for the electric conductors.

441,304. Annunciator; Charles W. Holtzer, Brookline, Mass. Application filed Aug. 19, 1890. An annunciator comprising a main frame-plate and electro-magnet connected therewith, and second frame-plate connected with the first and provided with lugs constituting a pivot-bearing for the armature of said magnet, and a stop for arresting the said armature integral with said frame-plate, a rock shaft having its pivot-bearings in said plates, and having connected with it an indicator and a detent arm forming an integral portion of said rock-shaft, and a magnet-armature pivoted in said lugs of the second frame-plate independently of said rock shaft and constituting the other member of said detent.

441,305. Electrically Propelled Vehicle; Rudolph M. Hunter, Philadelphia, Pa. Application filed Aug. 18, 1888. A car or vehicle having one or more compartments, in combination with two or more removable frames, each provided with a series of cells of battery and having two terminal contacts arranged in said compartments, hand-coupling device movably secured within the apartments upon the car or vehicle for coupling up the terminals of the different series of cells of battery, a circuit on the car or vehicle, including said battery cells and hand couplings, and a translating device in said circuit.

441,312. Suspending Device for Electric Wires; Walter Booth Marks, John George Lauer, and Robert Randolph Ralston, of Richmond, Va. Application filed July 20, 1890. In an electrical street car motor, in combination, the electrical conducting wire, the supporting wire above the electrical wire, and flexible suspenders between the posts upon which the supporting and conducting wires are sustained, said suspenders comprising, respectively, an insulating portion, having a transverse eye and a grooved periphery, and being spaced at short intervals between the posts, substantially as described.

441,330. Method of Operating Electric Brakes for Electrically Propelled Cars; William M. Schlesinger, Philadelphia, Pa. Application filed Jan. 28, 1888. The method for operating or applying electrically controlled or actuating brakes on an electrically propelled car, which consists of first cutting the car motor out of the generator or supply current or circuit to convert said motor into a generator driven by the momentum of the car, and then successively using the armature-current of the motor and the line or supply current to successively actuate said brake appliances.

441,391. Method of Winding Dynamo Armatures; Charles Eugen Lancelot Brown, of Zurich, Switzerland. Application filed Feb. 5, 1890. The method of winding dynamo-armatures, consisting in winding one layer of wires upon the drum, placing a suitable continuous insulation upon said layer of wires, and then winding a second layer of wires upon the insulation.

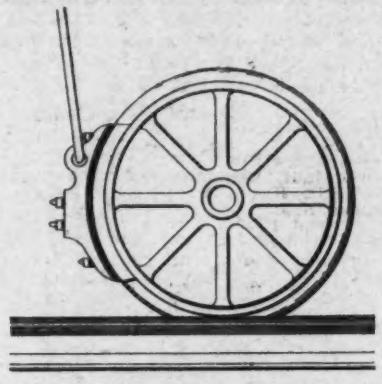
441,396. Telephone; Frank L. Capps, Springfield, Ill. Assignor of one-half to Albert L. Ide, of same place. Application filed April 7, 1890. The combination, with a permanent magnet of a vibrating armature interposed between the poles of a magnet and a stationary coil connected in the line circuit and surrounding the said vibrating armature with its axis arranged longitudinally relatively to the armature.

441,401. Method of Electric Welding and Metal-Working; Mark W. Dewey, Syracuse, N. Y., Assignor to the Dewey Corporation of same place. Application filed Sept. 5, 1890. The method of electrically heating a bar or blank for welding or working purposes, consisting in connecting the said bar or blank with one terminal of an electric generator, embedding the portion of the bar or blank to be worked in a yielding bed of conducting material in connection with the other terminal, and passing a suitable heating current through the bar or blank or a portion thereof and the yielding bed.

441,403. Galvanic Battery; Oscar A. Enholm, New York, N. Y. Assignor, by direct and mesne assignments, to the Enholm Electrical Construction Company, of same place. Application filed April 21, 1890. The combination of a cell and an internal cup, forming two compartments in the cell, with a removable frame supported by said cup and insulated therefrom, said frame carrying both the positive and negative electrodes, one of said electrodes being insulated from said frame.

441,413. Secondary Battery; George E. Hatch, of Cambridge, Mass., Assignor to David H. Burrell, of Little Falls, and Jean R. Stebbins, of Watertown, N. Y. Application filed Feb. 13, 1890. A storage battery having intermediate plates of stiff porous material alternating with its conducting plates.

441,458. Automatic Electric Gas-Lighter; LeRoy S White, Waterbury, Conn., Assignor to the Electrical Appliance Manufacturing Company, of same place. Application filed May 23, 1890. The combination with an electro-magnet and coils of a circuit breaker comprising contact-pieces, a housing acting as a



No. 441,215.—INSULATED BRAKE.

guide for one of the contact-pieces, a spring acting against said contact-piece, and a vibrating part, a rod provided with a valve, the armature and hooks engaging in notches in said armature.

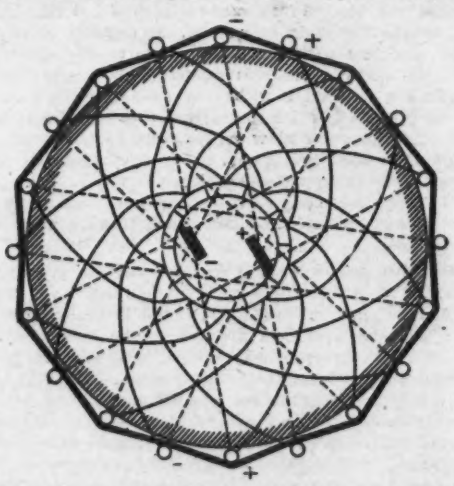
441,487. Wire Joint for Commutators; Walter E. Harrington, Atlantic City, New Jersey, Assignor of one-half to Leonard Atwood, of Philadelphia, Pa. Application filed Aug. 28, 1890. The combination of the commutator plate provided with an orifice wire, a sleeve covering the ends of said wire and adapted to the orifice in the commutator-plate, and means for securing the sleeve and wires to said plate.

441,542. Device for Transforming and Controlling Electric Currents; Oscar A. Enholm, New York, N. Y., Assignor, by direct and mesne assignments, of six-tenths to Julius M. Heyman, George W. Venable and Moses J. Heyman, all of the same place. Application filed Feb. 20, 1890. The combination, with a core and a primary and secondary circuit, each having a coil, of a frame, connecting the ends of said core, a vacuum case supported on said frame, the terminals of the primary circuit arranged at an angle to each other in said case, an armature having a bridge-piece adapted to contact with said terminals, and a spiral spring bearing upon the floor of said case and surrounding and supporting said armature for closing the primary circuit.

441,543. Arc Lamp; Oscar A. Enholm, New York, N. Y., Assignor of one-half to Julius M. Heyman, of same place. Application filed Feb. 20, 1890. In an arc lamp the combination of the regulator-rollers mounted on resilient supports and provided with braking-rollers and a carbon holder, arranged to operate in connection therewith.

441,565. Electrically Propelled Vehicle; Rudolph M. Hunter, Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed Oct. 26, 1886. In an electrically propelled vehicle, combination of two axles, a motor hinged to each of said axles, power transmitting connections between the motor shafts and the axles, a double-armed spring secured to the vehicle frame, and a connection between the motors and the free ends of the spring.

441,571. Electric Railway; Hosea W. Libbey, Boston, Mass. Application filed Sept. 23, 1889. A conduit for electric railways, divided vertically into parts, one part being slightly



No. 441,391.—METHOD OF WINDING DYNAMO ARMATURES.

larger than the other and provided at its lower end with a recess forming a gutter, the two parts of said conduit being each provided with a flange and connected together with bolts.

441,572. Electric Railway; Hosea W. Libbey, Boston, Mass. Application filed Oct. 9, 1889. A rail rolled to such a form as to leave a space between the tread and bearing surface and having grooves into which the ends of springs are inserted, the said springs supporting an electric conductor.

441,588. Electrical Switch; George Schultz, of Old Charlton, England. Application filed July 29, 1890. In an electrical switch, the combination of an insulating incombustible base having two separate contacts, an arch frame secured to the base, a lever pivoted at its upper portion to the arched frame and having at its lower end a yielding insulated contact-piece to spring in between the two contacts, and a spring having connections with the lever and the arched frame to which said lever is pivoted, said spring exerting no strain on the lever when its contact-piece is sprung between the two contacts on the base, but exerting strain on the lever when the latter is moved to withdraw its contact-piece from between the contacts on the base.

441,622. Electrical Thermostat; Charles H. Shaffer, Rockford, Ill. Application filed May 9, 1890. An electrical thermostat consisting of a base, a spring-actuated arm held against its spring force by a lever resting on a fulcrum, and a link of fusible alloy, whereby the spring arm is released by the melting of the link and closes the circuit in which the thermostat is placed.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.